2015

Raider Outboards Titusville, FL 32796



SERVICE MANUAL

Raider 40 Horsepower

Submersible /
Multi-Fuel
Outboard Motor

Part No. R40-ES-001

[Raider Service Manual No. R40-ES-001-15-3 Instructions for repair the Raider 40 Outboard Engine - Shop Manual

For Military Use Only

TABLE OF CONTENTS

Service Safety	
General Information	2
Fuel System	3
Powerhead	4
Midsection	5
Gearcase	6
Electrical System	7

TABLE OF CONTENTS

Section 1 Service Salety	5
Introduction	
Safety Statements	6
Safety Precautions	
Hazardous Materials	
Shop Environment	
Workmanship Standards	
Test Tank Guidelines	11
Section 2 General Information	12
General Precautions	12
Abbreviations and Symbols	13
Unit Conversions	14
Specifications/Standard Torque Values	15
Special Tools required for repair	16
General Equipment Required	18
Lubrication of Raider 40	22
Periodic Inspections	26
Break In Procedure	29
Tune Up Procedures	30
Emergency Stop switch and lanyard	31
Synchronization and Linkage Adjustment	32
Fuel Induction System	33
Anodes – Inspection and Testing	34
,	35
General Precautions	35
Service Specifications	35
General Equipment Required	36
Fuel System Requirements	
Fuel System Operations	37
Troubleshooting Fuel Issues	. 38
Description of Operation	. 39
Fuel Pump	
Fuel Induction System (Carburetor)	
Recirculation	
Fuel Bladder Connection	
Fuel Line Description	
Disassembly – Fuel Pump	
Reed Valve	44

Section 4 Powerhead	47
General Precautions	47
Service Specifications	47
Manufacturers Special Tools Required	48
General Equipment Requirements	48
Consumables	48
Troubleshooting Powerhead	49
Description of Operation	50
Thermostat	51
RPM Performance Test	52
Recoil Starter	53
Pull Start Diagram	55
Flywheel	56
Raider Engine Block Diagram	58
Removal of Raider Engine	59
Disassembly of Raider Powerhead	61
Assembly of Raider Powerhead	71
Section 5 Midsection	77
General Precautions	77
Service Specifications	77
General Equipment Required	77
Consumables Supplies Required	78
Tiller Steering Handle	78
Handle and Linkage	81
Lower Engine Cover	88
Driveshaft Housing	89
Stern Bracket	94
Swivel Bracket and Reverse Lock	95
Section 6 Gearcase	96
General Precautions	96
Service Specifications	96
Special Equipment Required	97
General Equipment Required	98
Consumables Required	98
Waterpump	98
Gearcase	103
Backlash	115
Gearcase Repair Procedures	119
•	
Section 7 Electrical System	123
General Precautions	123
Service Specifications	124
Electrical Servicing Standards	124
Troubleshooting	127
Description of Operation	129
Battery Care and Maintenance	132
Ignition System	147
Ignition System Repair Procedures	163
Starting System	171

SECTION 1 - SERVICE SAFETY

⚠ MARNING

Inadequate knowledge of safe shop practices can result in severe injury or death. Review general safety procedures and specific safety information provided for each procedure prior to beginningany repairs.

INTRODUCTION

Raider outboards is required to comply with special EPA regulations and standards to ensure your military products are safe and reliable. As the military technician, it is your responsibility to keep these products safe when performing normal repair and maintenance operations.

It is not possible to foresee all safety hazards which may occur or to include all the knowledge of an experienced technician in a single service manual. Therefore, it is assumed those using this manual have a working knowledge of 2-cycle outboard engines and the proper technical training for servicing.

Raider outboards is considered a Commercial Off The Shelf (COTS) outboard engine. The engine comes from a family of engines: Mercury, Nissan and Tohatsu. Most major parts can be obtain from any dealer – world wide. For Raider specific parts these are available within one day.

This section discusses safe shop practices and general safety concerns relevant to the operations performed throughout this manual. Read this section carefully and follow all safety statements in this manual as they pertain to the procedures at hand. Remember, always use common sense when servicing outboard engines!

Raider supports three manuals:

Owner/Operators Manual; R40-ES-001-15-1;

Parts and Assembly Manual: R40-ES-001-15-2 which has all part numbers

and assembly information; and

Service Manual R40-ES-001-15-3 that provides complete information to repair the Raider 40.

SAFETY STATEMENTS

The following safety statements are found throughout this manual indicates information which, if ignored, could result in safety hazards or faulty service.

A DANGER

Indicates the presence of a hazard which, if ignored, **WILL** result in severe injury or death.

⚠ MARNING

Indicates the presence of a hazard which, if ignored, **COULD** result in severe injury or death.

A CAUTION

Indicates the presence of a hazard which, if ignored, **COULD** result in minor personal injury or damage to product, equipment, or other property.

NOTE

Indicates special information to facilitate the installation, operation, or maintenance of the product or further clarify information which is important but not hazard related.

SAFETY PRECAUTIONS

Raider Outboard Engines

Never disable the neutral switch start-in-gear prevention system. Always test the neutral switch and emergency stop switch before returning an engine to the user.

Lifting devices and hardware must be of suitable capacity for the weight of the outboard engine. Be aware the engine may swing outward when lifted.

The Raider engine stand must be in good condition; Raider engine must be mounted properly to prevent unexpected shifting.

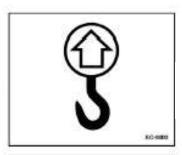
Engine covers (cowling) are guards to prevent personal contact with the spinning flywheel and high voltage components such as spark plugs and coils. Never wear jewelry or loose clothing near a running engine. Keep hands, arms and hair away from the flywheel. Never touch electrical components when the engine is running.

Two people working on a running engine must use extreme caution and be aware of one another. Never attempt to start an engine or operate any controls before signaling your partner.

To prevent accidental startup during operations which may cause the flywheel to turn, always perform the following steps:

- 1. Insure battery is disconnected or removed.
- 2. Disable the engine ignition system.
- 3. Shift engine to NEUTRAL and verify propeller shaft is not in gear.

Rotating propellers are not equipped with guards and can cause severe injury or dismemberment. Always stay clear of rotating propellers and make sure there is no possibility of engine startup before removing or installing a propeller. The propeller nut must always be tightened to torque specification prior to starting the engine.







Additional Safety Precautions

Avoid running the engine at high RPM. Engine speed can easily increase to excessive RPM when under a no load condition. To avoid engine damage during testing, always use the correct test propeller and keep engine speed below 2000 RPM.

Run engines only in well ventilated areas to prevent exposure to Carbon Monoxide (CO) gas. Direct and prolonged exposure to CO will cause brain damage or death.

Always wear eye protection, protective clothing, gloves and use other applicable safety equipment when work activities present the risk of personal injury.

Batteries

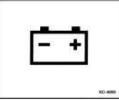
Never leave batteries in Raider outboards for long periods of time. Always unplug when not in use.

Place batteries on "maintainer" when not in use.

Never use "fast" charge on batteries that are used on vehicles. These batteries are sealed lithium Iron; 270 Cranking Amps.

- Prior to Mission place on maintainer for 6 hours
- Battery can be left in RAMZ for up to three months.
- Disconnect internal connection when placed in RAMZ.
- If detection of heat in battery remove and discard.
- Make sure battery looks in good condition.







Hazardous Materials

Gasoline vapors are highly flammable and can cause an explosion. Never smoke or allow sparks or flames nearby when handling fuel Always store gasoline in a shaded, well ventilated area in an approved safety container.

Heavy Fuels that can be burned in the Raider 40 has harmful fumes that must be considered hazardous. Wear masks.

Ventilate all fumes as soon as detected. Be aware that appliance pilot lights, such as those in furnaces and water heaters, can ignite gasoline vapors and cause explosion.

Never use gasoline as a cleaner, and always clean up fuel spills immediately and properly dispose of rags in an approved safety container.

Read and follow the safety labels on products used around the shop. Adhesives, lubricants, solvents, and fuel additives are usually poisonous and flammable. Store and dispose of these products properly.

Shop Environment

Make sure the shop and your work area are properly ventilated.

Shops must be equipped with the proper tools and safety equipment such as fire extinguisher, eye flushing device, and first aid kit.

Keep the shop clean and free of clutter. Clean up spills on the floor as soon as possible to prevent someone from slipping.

WORKMANSHIP STANDARDS

- 1. Avoid damage to the mating surfaces of crankcase and cylinder assembly. Do not use a sharp metal scraper to clean these areas.
- 2. Replace gaskets, 0-rings, seals, cotter pins, lock nuts, and spring pins when removed during repair operations.
- 3. Use only genuine factory replacement parts and accessories.
- 4. Use recommended special tools when specific repairs require them.
- 5. Calibrate measurement tools and test equipment on a regular basis.
- 6. Clean all metal parts with solvent before inspection and assembly operations.
- 7. Use penetrating solvents when necessary to remove rusted or seized hardware.

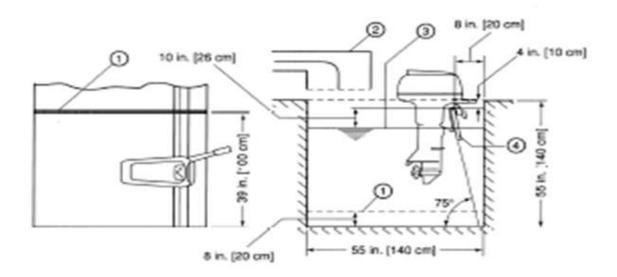


- 8. Keep all removed parts separated for ease of identification during assembly.
- 9. Locate alignment marks on components being disassembled. If marks are not present and should be, scribe or match mark them yourself to ensure the pieces are assembled properly.
- 10. Follow torque sequences and specifications where they apply. First, tighten each bolt in the specified sequence. Use the same sequence to torque each bolt to final specification. Special torquespecifications are listed at the beginning of each section. Standard torque specifications for common fasteners are listed in Section 3.
- 11. Use lubricant when assembling seals to prevent damage to the seal lips. Make sure seal lips are facing the correct direction.
- 12. Use the correct type and amount of sealing compound on metal to metal surfaces.
- 13. When using compressed air to clean or dry parts, make sure air supply is regulated not to exceed 25 psi [172 kPa /1.76 kg/cm'].
- 14. Replace missing or damaged safety labels on the engine before returning it to the user.

TEST TANK GUIDELINES

When properly setup, test tanks provide a safe and controlled environment in which to perform outboard engine adjustment and testing procedures. Test tanks must be setup to the minimum dimensions shown. If multiple engines will be installed in the tank, secure partition plate (1) so that the minimum dimensions are maintained for each outboard engine installed. In addition, adhere to the following guidelines to prevent engine damage:

- Continuous usage raises the water temperature in the tank which can lead to engine seizure. Make sure water temperature in the tank does not exceed 77°F [25°C].
- Repeated use introduces carbon into the water which can adhere to the engine cooling system and degrade its ability to cool the engine. Always replace dirty tank water at regular intervals with clean, fresh water.
- Exhaust gases produced during engine operation can collect around the engine, causing suction into the carburetors and affecting engine performance. To prevent this condition, install forced ventilation equipment (2) to remove gases away from the engine and work area.
- Water may splash out of the tank during testing. Maintain water level (3) in the tank as illustrated.
- Keep transom board (4) at an approximately 75° angle to the tank bottom to ensure near vertical engine position.
- Test Tank Drawing:



SECTION 2 – General Information

General Precautions

Before performing any service work on the outboard engine, read and understand Section 1 - Service Safety.

Use only genuine factory replacement parts with equivalent characteristics such as type, material, and strength. Failure to do so may result in product malfunction and injury to the operator or passengers.

Follow the **Standard Torque Values** chart. When a special torque value for a certain fastener is not listed in the **Special Torque Values** chart at the beginning of each section tighten as normal.

Rather than just repairing a bad part, use repair kits and overhaul kits when applicable to ensure complete and efficient repair of the complete component. Wear not readily noticed on other parts can lead to malfunction soon after the repair.

When indicated in a procedure, use manufacturer special tools. In some cases, the use of substitute tools will damage the part.

When using compressed air to clean or dry parts, make sure air supply is regulated not to exceed 25 psi [172 kPa / 1.76 kg/cm'].

Abbreviations and Symbols

Abbreviations

Α	ampere	L	liter
AC	alternating current	L/hr	liter per hour
AH	ampere-hour	lb	pound
approx.	approximately	mL	milliliter
API	American Petroleum Institute	mm	millimeter
ATDC	after top dead center	mV	millivolt
BTDC	before top dead center	N	newton
°C	degree Celsius	N·m	newton meter
CCA	cold cranking amp	NMMA	National Marine
cm	centimeter		Manufacturers Association
cm ³	cubic centimeter	No.	number
cm³/min	cubic centimeter per minute	O.D.	outside diameter
cu-in	cubic inch	oz	ounce
DC	direct current	PS	horsepower (metric)
DVA	direct volt adapter	psi	pound per square inch
Kg-m	kilogram meter	qt	quart (U.S.)
°F	degree Fahrenheit	RPM	revolution per minute
fl oz	fluid ounce (U.S.)	SAE	Society of Automotive Engineers
fl oz/min	fluid ounce (U.S.) per minute	sec.	second
ft	foot	t	short ton 2000 lb
ft-lb	foot pound	TDC	top dead center
ft-lbf/min	foot pound force per minute	V	volt
g	gram	VAC	volt alternating current
gal/hr	gallon (U.S.) per hour	VDC	volt direct current
gal	gallon (U.S.)	W	watt
ĞL	gear lubricant		
GM HP	General Motors Company horsepower (U.S.)	Symbols	

GM	General Motors Company	Symbols	
HP	horsepower (U.S.)		
I.D.	inside diameter	•	angular degree
in	inch	+	plus
in-lb	inch pound		minus
kg	kilogram	±	plus or minus
kg/cm ²	kilogram per square centimeter	Ω	ohm
ESG	electronic speed governor	μ	micro
kPa	kilopascal	%	percent
kW	kilowatt		
(4,050,0)	0.0000000000000000000000000000000000000		

Unit Conversions

Unit Prefixes		
Prefix	Symbol	Power
mega	M	x 1,000,000
kilo	k	x 1,000
centi	C	x 0.01
milli	m	x 0.001
micro	ш	x 0.000001

Units of Length

mile	×	1.6090 = km
ft	X	0.3050 = m
in	X	2.5400 = cm
in	X	25.4000 = mm
km	x	0.6210 = mile
m	X	3.2810 = ft
cm	x	0.3940 = in
mm	x	0.0394 = in

Units of Volume

gal (U.S.)	X	3.78540 = L
qt (U.S.)	X	0.94635 = L
cu-in	X	0.01 639 = L
cu-in	X	16.38700 = mL
fl oz (U.S.)	X	0.02957 = L
floz (U.S.)	X	29.57000 = mL
cm ³	X	1.00000 = mL
cm ^a	X	0.03382 = fl oz (U.S.)

Units of Mass

lb	x	0.45360 = kg
oz	x	28.35000 = g
kg	x	2.20500 = lb
g	X	0.03527 = oz

Units of Force

lbf	×	4.4480 = N
lbf	X	0.4536 = kgf
N	X	0.2248 = lbf
N	X	0.1020 = kgf
kgf	×	2.2050 = lbf
kgf	х	9.8070 = N

Units of Torque

ft-lb	×	1.3558 = N-m
ft-lb	×	0.1383 = kg-m
in-lb	×	0.1130 = N-m
in-lb	×	0.0115 = kg-m
kg-m	×	7.2330 = ft-lb
kg-m	×	86.8000 = in-lb
kg-m	×	9.8070 = N-m
N-m	×	0.7376 = ft-lb
N-m	×	8.8510 = in-lb
N-m	×	0.1020 = kg-m

Units of Pressure

×	0.0689 = bar
	6.8950 = kPa
	0.0703 = kg/cm ²
	14.5030 = psi
	100.0000 = kPa
	29.5300 = in Hg (60°F)
	0.1450 = psi
	0.0100 = bar
	0.0102 = kg/cm ²
	14.2200 = psi
	0.9807 = bar
	98.0700 = kPa
	0.0333 = bar
	3.3770 = kPa
	0.0344 = kg/cm ²
	x x x x x x x x x x x x x x x x x x x

Units of Power

HP	×	1.01400 = PS
HP	×	745.70000 = W
HP	×	550.00000 = ft-lbf/s
PS	×	0.98630 = HP
PS	×	735.50000 = W
PS	×	542.50000 = ft-lbf/s
W	×	0.00134 = HP
W	×	0.00136 = PS
W	×	0.73760 = ft-lbf/s
kW	×	1.34100 = HP
kW	×	1.36000 = PS
kW	×	737.56000 = ft-lbf/s
ft-lbf/s	×	0.00181 = HP
ft-lbf/s	×	0.00184 = PS
ft-lbf/s	×	1.35600 = W

Units of Temperature

```
°F = (1.8 • °C) + 32
°C = 0.556 • (°F - 32)
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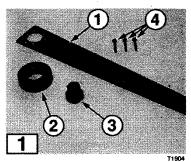
Service Specifications

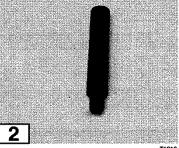
Standard Torque Values

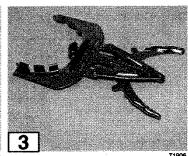
	Torque						
Size	in-lb	ft-lb	N-m	kg-m			
M4	10 - 17	0.8 - 1.4	1 - 2	0.1 - 0.2			
MS	26 - 35	2.2 - 2.9	3 - 4	0.3 - 0.4			
MS	44 - 52	3.6 - 4.3	5 - 6	0.5 - 0.6			
MS	97 - 133	8 - 11	11 - 15	1.1 - 1.5			

These torque values apply only when a special torque specification is not listed in the Special Torque Values chart at the beginning of each section.

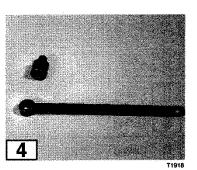
Special Tools for Repair - Raider 40

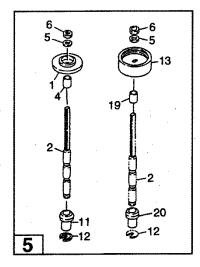


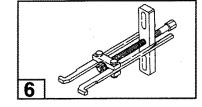




1ª	D-4 M-	0
Tool Description	Part No.	Components
Flywheel Puller Assembly	369-72211-0	Arm ① Adapter ② Pressing Bolt ③ Bolts ④
2 Piston Pin Tool	345-72215-0	
3 Piston Ring Tool	353-72249-0	
Wrench, Bevel Gear B Nut	346-72231-0	Wrench
Socket, Bevel Gear B Nut	345-72232-0	Socket
Needle Roller Bearing Puller	3C8-72700-0	Kit
5 Flange A	3C8-72701-0	①
5 Shaft	346-72702-0	@
5 Shaft Stopper A	346-72704-0	· ④
5 Washer	346-72707-0	⑤
5 Nut, 12P=1.25	346-72706-0	6
5 Guide A	345-72705-0	0
5 Retainer A	345-72703-0	13
5 Flange B	346-72701-5	13
5 Shaft Stopper B	345-72704-5	19
5 Guide	345-72705-5	છ
Bevel Gear Bearing Puller	3A3-72755-0	Assembly



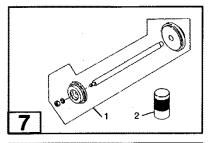


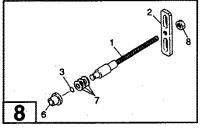


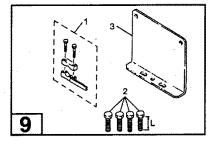
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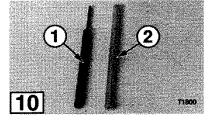
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Tool Description	Part No.	Components
Bearing Outer Press Kit	3B7-72739-0	Kit, ①
Bevel Gear Bering Installing Tool	3C8-72719-0	② , Ø 42 mm
8 Backlash Measuring Tool	3C8-72234-0	Kit
8 Shaft	345-72723-0	1
8 Plate	3A3-72724-0	@
8 O-ring	332-60002-0	3
8 Collar	353-72245-1	6
Cone Disk Spring, d=12	345-72763-0	⑦ , 3 pcs
8 Nut, M10	930191-1000	8
9 Clamp Assembly	3B7-72720-0	①
9 Bolt, H625	910191-0625	2 for lower pump case
9 Plate, Dial Gauge	3B7-72729-0	3
10 Spring Pin Tool A	345-72227-0	Pin Punch
10 Spring Pin Tool B	345-72228-0	Hollow Punch
11 Clutch Pin Snap Tool	345-72229-0	1 = 2.36 in 60 mm
12 Shimming Gauge	3C8-72250-0	①
12 Thickness Gauge	353-72251-0	2
13 Rubber Mount Puller	361 -72760-0	Kit
Tool Box	353-72254-0	

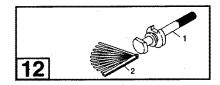


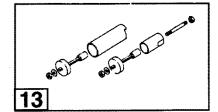












General Equipment Required

Water Pressure Gauge, 0 - 15 psi [0 - 103 kPa / 0 - 1 kg / cm²]

Fuel Pressure Gauge, 0 - 15 psi [0 - 103 kPa / 0 - 1 kg / cm²]

Torque Wrench, 0 - 150 in-lb [0 - 17 N·m / 0- 1.7kg-m]

Torque Wrench, 0 - 750 ft-lb [0 - 1000 N·m / 0 - 100 kg-m]

Dial Gauge, minimum scale 0.0001 in [0.01 mm]

Micrometer Set or Dial Caliper, minimum scale 0.0001 in [0.01 mm]

Telescoping Gauge, Inside Micrometer Set, or Dial Caliper, minimum scale 0.0001 in [0.01 mm]

Variable Load High Rate Discharge Tester, Electronic Specialties® Model 700 or equivalent

Analog Multimeter, Electronic Specialties® Model M-530 or equivalent

Digital Multimeter, Electronic Specialties® Model KD 3200 or equivalent

Digital Pulse Tachometer, 10 - 6000 RPM, Electronic Specialties® Model 321 or equivalent

Ammeter, 0 - 100 A

Gearcase Pressure Tester, Stevens* S-34 or equivalent

Gearcase Vacuum Tester, Stevens® V-34 or equivalent

Engine Compression Gauge, 0 - 300 psi [0 - 2000 kPa / 0 - 20 kg/cm²]

Spark Gap Tester, Stevens® S-13C, S-48, or equivalent

Flexible Fuel Tubing, 1/4 in I.D. x 5 in [6 mm I.D. x 127 mm]

Flexible Fuel Tubing, 3/8 in I.D. x 5 in [9.5 mm I.D. x 127 mm]

Industrial Thermometer, minimum 300°F [150°C]

Heat-Resistant Container, Pyrex®

Bearing Puller

Seal Pullers

Seal Installers

Heat Gun

Hydrometer

Consumables Required

Threadlocker, *Loctite 242* Threadlocker, *Loctite 243*

Gasket Dressing, Permatex Hylomar Aerosol High-Temp Gasket Dressing

Gasket Sealant, Permatex High Tack Gasket Sealant

Anaerobic Gasket Maker, Loctite 518

Silicone Sealant, *Permatex" Hi-Temp RTV Silicone Gasket* Super Bond Adhesive, *Permatex Super Glue Gel* Cleaning Pads, *Scotch-Brite Abrasive Pads*

Low Temperature Lithium Grease

Genuine Grease or Equivalent Friction Surface Marine Grease

Power Trim/Tilt Fluid, Raider• power torque fluid or GM approved automatic transmission fluid

isopropyl Alcohol Cleaning Solvent Gasket Remover

Gear Lubricant, *Genuine gear oil or AP/ grade GLS, SAE #80 - #90* Engine Lubricant, *Genuine engine oil or NMMA certified TC-W3 oil* Automotive Crankcase Oil, flashpoint above 300'F [150°C]

Battery Spray Protector, Permatex Battery Protector & Sealer

Electrical Shrink Tubing, various diameters

Form-A-Gasket, Permatex (Aviation Sealant Liquid) – Head Gasket

Corrosion Zero – anti-corrosion spray can

Raider 40 - Specifications

Operational

Power

Raider40 HP [29.4 kW]

Full Throttle RPM Range

Raider5200 - 5800

Idle RPMIn GearNeutralRaider......8501000

Fuel Consumption at Full Throttle

Raider4.0 g/hr

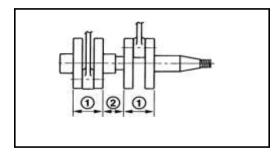
Multiple Fuels

Gasoline – primary – Heavy Fuel Optional JP-5/8; Kerosene; Diesel; Bio-diesel]

Submersible - special dewatering

66 feet underwater/18 hours – start 5 min.

Crankshaft Dimensions



Dimension 1

Raider 402.071 + 0 in

[52.6 + 0 mm] - 0.002 - 0.05

Dimension 2

Raider 40 1.591 \pm 0.002 in

 $[40.4 \pm 0.05 \text{ mm}]$

Clutch System

Raider 40 Dog clutch type (Forward-Neutral-Reverse

Electrical System

Ignition Type

Flywheel magneto capacitor discharge

Ignition Timing

See Ignition Timing Adjustment in Section 2

Spark Plug

Raider 40 Pulstar Model SBE 1/10

Spark Plug Gap

Raider 400.035 0.055 (not to exceed)

Battery (Sealed)

Raider 40Lithium Iron 270

CA

Test Propeller

Raider348-64111-0

Powerhead

Number of Cylinders

Raider2

Displacement

Raider.....30.08 cu. in [493 cm']

Standard Bore

Raider2.76 in [70 mm]

Stroke

Raider.....2.520 in [64 mm]

Piston Clearance

Raider 40 ...0.0020 - 0.0039 in [0.05 - 0.10 mm]

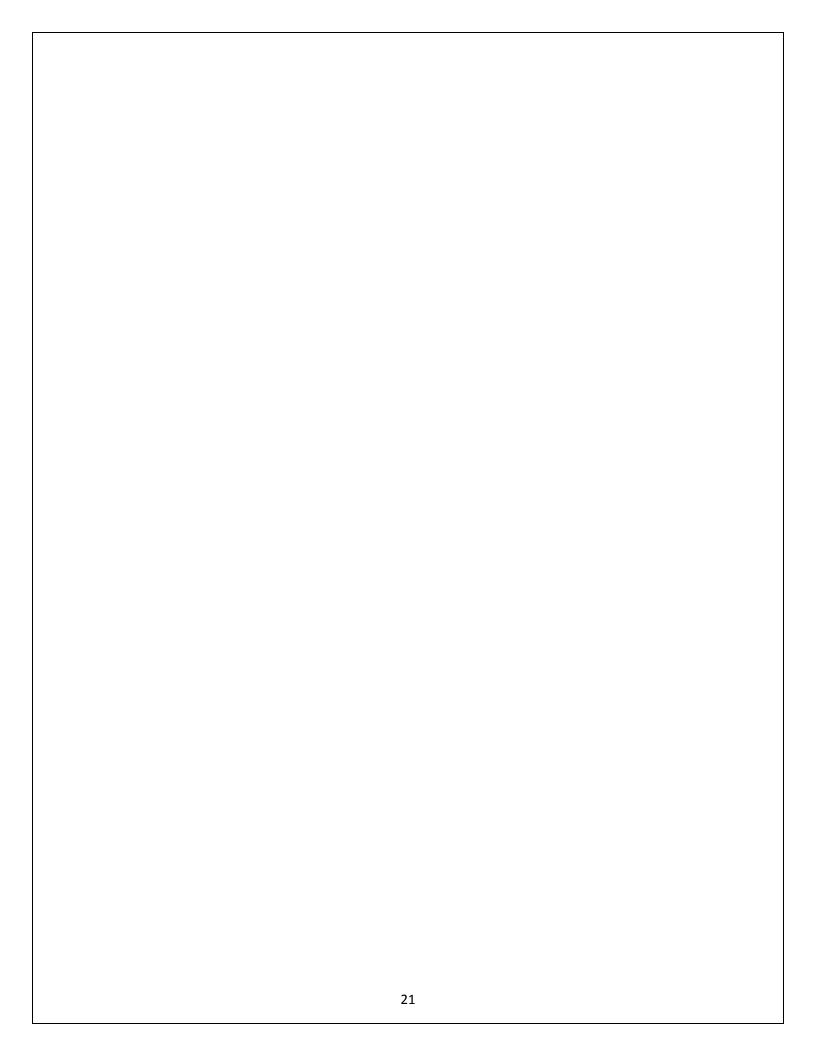
Piston Ring End Gap

Raider 400.008 - 0.016 in [0.20 - 0.40 mm]

Gearcase

Gear Ratio

Raider...... 13:25



Alternator Raider 4012V BOW **Charging Performance (at 5500 RPM)** Raider 405 A **Number of Tachometer-to-Alternator Coil** Impulses Raider 40 4 **Alternator Coil Resistance** Raider 40 Y-W: $0.65 - 0.98 \Omega$ $Y-B:0.31-0.47 \Omega$ W-B: $0.37 - 0.55 \Omega$ Ignition Coil Resistance (±25%) Primary Coil0.2 - 0.3 Ω Raider 40 Secondary Coil Raider 40......4.1-6.1 ΚΩ

Heavy Fuels: Raider Additive Required.

Fuel and Lubricant System

Required Fuel, Lubricant, and Mix Ratio See Fuel System Requirements in Section 3 50:1 normal mix; 30:1 break-in period.

NOTE

A special mix ratio is required during break-in. See "Break-In" at end of this section.

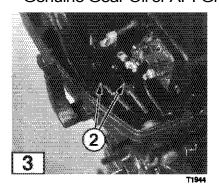
Lubrication of Raider 40

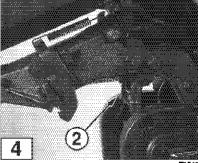
NOTE

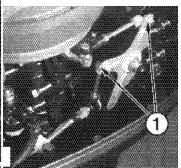
Recommended intervals are for <u>freshwater</u> military operation.

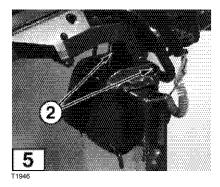
Decrease interval by 50% for salt water and severe duty operation.

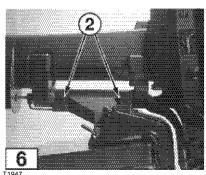
Lube Type: Low Temperature Lithium Grease Genuine Grease or equivalent Friction Surface Marine Grease Non-flammable solvent Genuine Gear Oil or API Grade GL5 #80 - #90



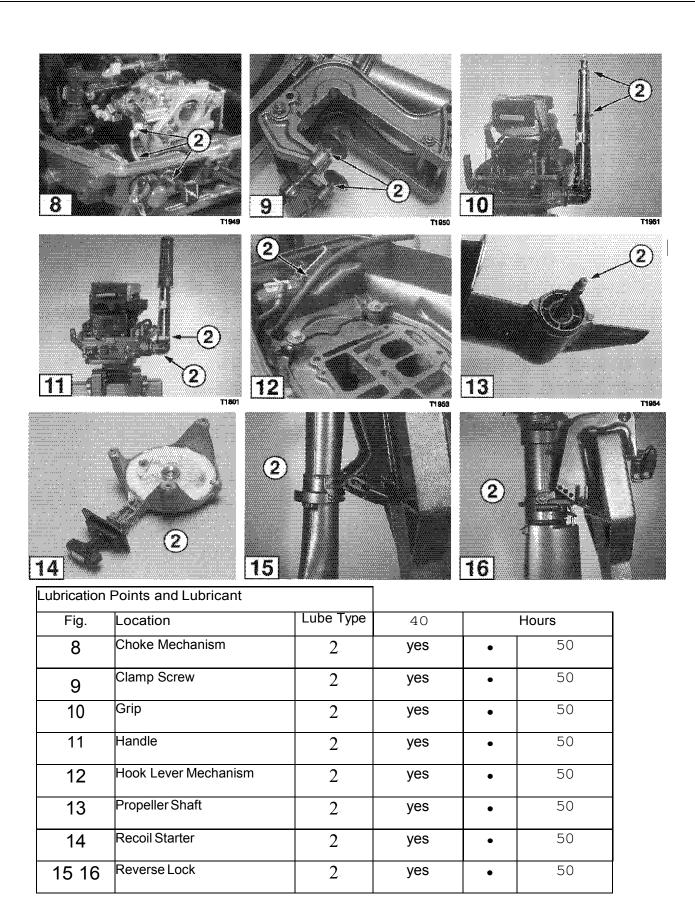


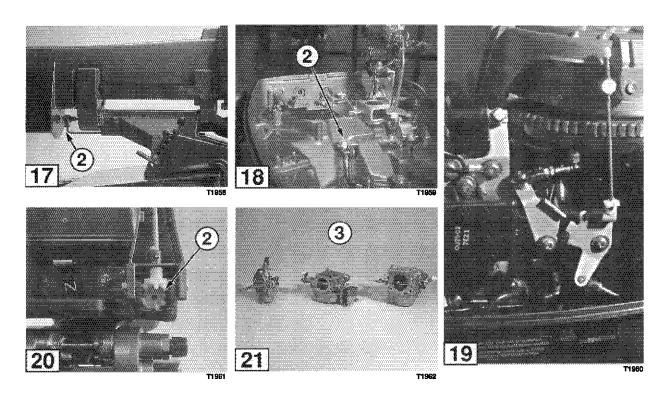






	Lubrication Points and Lubric			
Fig.	Location	Lube Type	40	Running Hours
1	Shift Lever Mechanism	1	yes	50
2	Throttle Linkage	1	yes	50
3	Throttle Cable	2	yes	50
4	Tilt Stopper	2	yes	50
5	Bracket Bolt	2	yes	50
6	Bracket Shaft	2	yes	50
7	Fuel Ind. Sys. Cable	2	yes	50

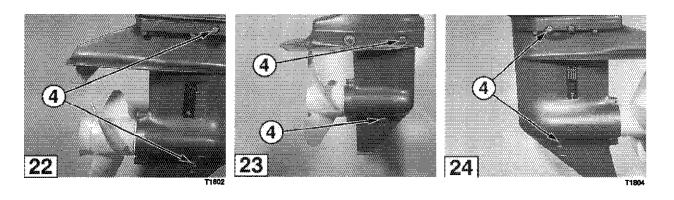




Lubrication	on Points and Lubricant			
Fig.	Location	Lube Type	40	Hours
17	Reverse Lock	2	•yes	50
18	Shift Lever Stopper	2	•yes	50
19	Starter Lock	2	•yes	50
20	Throttle Mechanism	2	•yes	50
21	Carburetor (Note 1)	2	•yes	100

Note 1:Disassemble, remove dust and clean with air and non-flammable solvent.

Completely dry all components and reassemble.



Lubrica	tion points and Lubricant	Free	quency	
Fig.	Location	Lube Type	Н	ours
22	First Gear Oil Change	4	Yes	10
23	Top Off Gear Oil	4	Yes	50
24	Oil Change (Note 2)	4	Yes	100

Note 2: Change Gearcase oil after every 100 hours of operation, and prior to prolonged storage, such as over the winter.

Commercial Fogger can be used in Fuel Induction System prior to long term storage.

Periodic Inspections

NOTE: It is recommended that a complete engine overhaul be performed after 400 operating hours.

14		Before	After 1st	Every		Every 100 Hrs	
Item	Inspection	Each Use	10 Hours 2 Days	30 Hrs or 7 Days	Hrs or 30 Days	or 60 Days	Remarks
Fastener torque	Check the following: Cylinder head bolts Cylinder head cover bolts Exhaust cover bolts Carburetor mounting bolts Intake manifold bolts Crankcase bolts Flywheel nut Starter motor installation bolts (where applicable) Driveshaft housing bolts Gearcase bolts Propeller shaft housing bolts Propeller nut Lower engine cover mounting bolts Engine mounting bolts		•		•		Torque to specification.
Gearcase	Check oil level andadd oil as required. Check for water or metallic matter in gear oil.			•			See Lubrication Chart in this section.
Spark Plugs	Check plug gap. Remove carbon deposits.		•		•		Replace plugs when electrodes are
System	Disassemble and clean. Check float valve for wear.					•	Replace worn partsas required.
Fuel Tank, Pick-up Tube, Filters, and Fuel Pump	Disassemble, clean, and inspect. Check for leakage. Check for cracks.		•		•		
Fuel and Recirculation Hoses	Clean and inspect Check all hose clips.					•	Replace hoses every 2 years.

Item	Inspection	Before Each Use	After 1st 10 Hours 2 Days	Every 30 Hrs or 7 Days	Every 50 Hrs or 30 Days	Every 100 Hrs or 60 Days	Remarks
Engine Compression	Check with compression gauge				•		Obtain normal operating temperature and check at full throttle.
Water Pump	Check for wear and damage.				•		Replace impeller every 200 hours (12 months).
Coolingand Exhaust Components	Remove dirt and deposits from the following: Water pump and impeller Water pipe Thermostat Exhaust cover Exhaust pipe Engine base Reverse gas passage					•	
Power head Cleaning	Inspect and remove carbon deposits from the following: Cylinder head Pistons Rings Inner exhaust cover Outer exhaust cover					•	Check every200 hours (12 months).
Electrical Wiring	Check for loose connections Inspect wires and insulation fordamage		•			•	
Ignition Timingand FIS	Check andadjust timing Adjust linkage.		•			•	See Synchronization and Linkage Adjustments in this section.
Throttle and Choke Valve Linkage	Inspect for the following: Loose balljoints and lock nuts Bent link rods Loose rod snaps		•	•			

Item	Inspection	Before Each Use	After 1st 10 Hours 2 Days	Every 30 Hrs or 7 Days	Every 50 Hrs or 30 Days	Every 100 Hrsor 60 Days	Remarks
Anodes	Inspect amount of erosion. Test for proper installation.				٠		Replace when anode has been reduced to 2/3 its original size(1/3 eroded). See Anodes - Inspection and Testing in this section.
Water Intake Screens	Check for blockages.	•					Remove and clean as required.
Checks	Check function and condition of the following: Water discharge from check ports Tiller or remotesteering controls Manual or remote clutch engagement Main switch key Emergency stop switch Drag link and hardware	•					

Break In Procedure – Raider 40

A CAUTION

Failure to follow the Break-In Procedure I Owner's Manual and special fuel mixture requirements for break-in may lead to serious engine damage and shortened engine life.

To prevent serious engine damage and ensure long engine life, new engines, used engines with new powerhead, used engines with newly rebuilt powerhead, and engines coming out of storage must be run for a period of 10 hours in accordance with break-in procedure.

⚠ CAUTION

After break-in has been successfully completed fuel bladder should be filled with a 50:1 ration gas/oil premix. If heavy fuels are to be used follow instructions on label.

First 10 Minutes (0 - 0.16 Hours)

- 1. Fill the fuel tank with a 25:1 gasoline to oil premix full synthetic only for Raider 40.
- 2. Operate the engine at minimum idle speed ONLY.
- 3. Verify a steady stream of water from the cooling water check port and idle port on the engine, indicating the water pump is functioning property.

Next 50 Minutes (0.16 to 1 Hour)

- 1. DO NOT operate the engine above 1/2 throttle.
- DO NOT maintain a constant throttle setting. Vary engine speed from 1/4 to 1/2 throttle every 15 minutes.

NOTE

Zodiac boats which comeonto plane easily, use full throttle to quickly accelerate onto plane; then immediately reduce throttle to 1/2 and maintain this speed. Wing Inflatable's – with Raider should not be any different.

Next Hour (1 to 2 Hours)

- 1. Use full throttle to quickly accelerate boat onto plane; then immediately reduce throttle to 3/4 and maintain this speed.
- 2. At intervals, run engine at ¾ throttle for 1-10 minutes then return to ½ throttle for a cooling period.
- 3. Vary engine speed every 15 minutes.
- 4. Check for water discharge from cooling water check ports.

Next Eight Hours (2 to 10 Hours)

- 1. Run engine at 3/4 throttle.
- 2. For short periods of time, run engine at full throttle and then reduce speed back to 3/4 throttle. As this part of the break-in period progresses, open to full throttle for longer and longer periods of time, but never longer than 5 minutes.
- 3. Vary engine speed every 15 minutes.

DO NOT exceed the Full Throttle RPM Range of the engine. See Engine Specifications in this section.

After Break-in Re-torque cylinder head bolts to specification after engine has been run and cylinder head has cooled to the touch.

Empty fuel tank and replenish with a 50:1 gasoline/oil mixture.

Tune Up Procedures

⚠ MARNING

Deteriorated or damaged parts identified during engine tune-up must be replaced in order to maintain safe engine operation.

- 1. Inspect engine for leaks, missing, loose or damaged parts, or other visible defects.
- 2. Remove each spark plug and check for fouling, cracks in ceramic, and incorrect gap... Replace plugs if needed.
- 3. Check engine compression. Refer to Cylinder Compression Test in Section 4.
- 4. Check all wiring, connectors, and clamps for damage. Replace parts as needed.
- 5. Replace fuel filter and inspect carburetor. Check fuel hoses for deterioration. Replace as needed.
- 6. Check for proper clutch engagement and make shift linkage adjustments as needed for proper operation of the reverse lock mechanism.

Model	Adjustment Part
	Shift lever stopper holder : Position onto Shift lever stopper plate

Adjust the engine ignition timing and Fuel Induction System. See Synchronization and Linkage Adjustments, this section.

Remove propeller and inspect propeller shaft oil seal for leakage. Inspect propeller thrust washer, and other propeller shaft hardware for damage. Replace as needed.

- 1. Drain and refill the Gearcase with gear oil. See Engine Specifications in this section.
- 2. Lubricate all engine components as specified in the Lubrication Chart, this section.
- 3. Verify that all bolts and screws are torque to specification by applying a torque wrench to each.
- 4. Run engine in test tank with proper test propeller and check for the following:
- Abnormal engine noise.
- Improper clutch operation.
- Little or no cooling water discharge from check port and idle port.
- Fuel leaks from mating surfaces of crankcase.
- Fuel leaks from mounting surface of intake manifold.
- Cooling water leaks from mating surfaces of cylinder head.
- Cooling water leaks from engine mounting surfaces.
- Cooling water leaks from exhaust cover mountingsurfaces.
- Improper idle RPM and stability.
- Defective stopswitch.

Emergency Stop Switch and Lanyard

The emergency stop switch and lanyard should be inspected and tested after servicing outboard. The operator should perform Emergency Stop function test with the boat in the water prior to leaving the launch area.

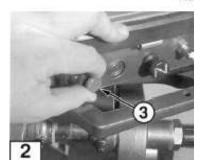
⚠ MARNING

Do not attempt to repair wom of faulty stop switch and lanyard. Replace only with genuine parts. Do not substitute.

Inspection

- 1. Inspect lanyard (1) for cuts or fraying, lock clip (2) for cracks.
- 2. Inspect stop switch assembly (3) for signs of wear and make sure the switch has adequate spring tension to hold the lanyard lock clip in place.

1



Stop Switch Test

- 1. Attach the lanyard lock clip to the stop switch.
- 2. Start the engine.
- 3. With the engine running, pull the lanyard to disengage the lock clip. Engine should stop running.

NOTE

The stop switch also operates as a push-button switch with the lanyard left attached.

4. Repeat the test but do not remove the lanyard. Press down firmly and hold the stop switch until engine stops running.

If engine continues to run in either test, the stop switch or wiring are faulty and must be replaced before engine is operated.

Synchronization and Linkage Adjustments

To ensure consistent engine idling and smooth operation throughout the full RPM range, it is important that each procedure be performed exactly as written and in the following sequence:

- 1. Ignition Timing Adjustment
- 2. Fuel Induction Synchronization

⚠ WARNING

Before beginning procedures, disable the ignition system (battery) to prevent accidental engine startup.

NOTE

The seam at the mating surfaces of the crankcase halves is the alignment point for all ignition timing degree measurements.

Throttle Setting	Full Open		Full Closed (In Gear)	
Raider	Match Mark Target RPM		Match Mark	Target RPM
40	BTOC 25°	5200 - 5800	ATOC 2°	850

Raider 40 Adjustment Procedure

Rotate the throttle grip to the FAST side until the throttle stops

Adjust ignition timing link so that the timing full open match mark is aligned with the fitting line (Crankcase Mating Surfaces).

Adjust the stopper bolt so that the advancer arm touches the full open stopper bolt when throttle is fully opened.

Turn the throttle grip toward SLOW side.

Adjust the stopper bolt (for full close adjustment) so that it hits the stopper bolt at the position where the magneto coil plate timing mark (fully closed side) meets the ignition timing inspection line (crank case mating surface).

A CAUTION

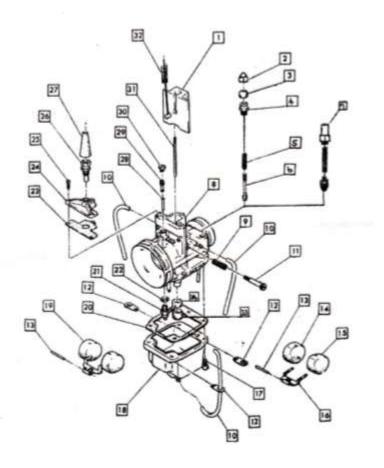
After making adjustments, check that the advancer arm moves freely and smoothly. Tighten adjusting nut after completing adjustments.

Fuel Induction System Adjustment

The Fuel Induction System (FIS) allows the Raider 40 to operate with multiple fuels. Advantages it can operate at any altitude without adjustments. To change from gasoline to heavy fuels turn three levers to "Green." Below is picture of FIS.

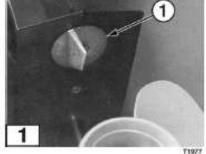


The cover on the front keeps debris from entering when submerged. The FIS breaks down the fuels to microscopic droplets due to the design of the venture; metering rod and engine harmonics. A rebuild kit is provided with spare parts.



ANODES - INSPECTION AND TESTING

Engines are equipped with several sacrificial anodes to help protect metal parts from the effects of galvanic corrosion (electrolysis). Disintegration of the anodes indicates they are performing their function. An anodes must be replaced when it has been reduced to 2/3 its original size (1/3 eroded). Engine corrosion will increase if eroded anodes are not replaced.



A CAUTION

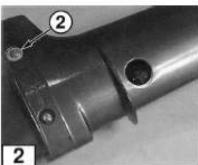
Do not paint or coat anodes or their mounting surfaces.

External Anodes

Anodes mounted externally on the engine should be inspected every 3 months, or more frequently if the engine is operated in salt or polluted water.







Powerhead Anode

The powerhead is protected by an anode mounted in the cylinder head or cylinder. The anode should be replaced whenever service work requires removal of the cylinder head, or when a complete overhaul of the engine is performed.

Installation Test

Use the following procedure to test for proper installation of the anode. Make sure the surface of the anode is clean before testing.

- Calibrate an ohmmeter on high ohms scale.
- 2. Connect one meter lead to a ground on the powerhead and the other lead to the anode. The ohmmeter should show a low reading. If not, remove the anode and clean the surface where it was mounted. The anode and its mounting hardware should also be cleaned. Install anode and retest.

SECTION 3 - FUEL SYSTEM

General Precautions

⚠ MARNING

Gasoline is extremely flammable and can explode if mishandled. JP-5/8 is also hazardous.

- 1. Before performing any service work on the fuel system, read and understand Section 1 Service Safety.
- 2. Before servicing the fuel system, disable the ignition system by removing all spark plug leads to prevent accidental starting of engine.
- 3. Fuel leakage can contribute to a fire or explosion. After service work is complete and engine is fully assembled, always run the engine momentarily to pressurize the fuel system. Then check for leaks.
- 4. Never attempt to run the engine with any fuel system component removed or disconnected.
- Check fuel hoses and other non-metallic component's for indications of damage or deterioration. Always replace components with authorized factory replacement parts suitable for fuel systems.
- 6. Clean up fuel spills immediately and store rags in approved containers. Keep drained fuel in approved containers for proper disposal.
- 7. When using compressed airto clean or dry parts, make sure the air supply is regulated not to exceed 25 psi [172kPa/1.76kg/cm2].

Service Specifications,

NOTERefer to Section 2 for Standard Torque Values chart.

Description		
	40	Torque
Fuel Induction Mounting Bolt	40 - 55 4.6 - 6.2 0.47 - 0.64	in-lb N·m kg-m
Air Silencer Cover Bolt/Screw•	43.2 - 54.6 4.9 - 6.4 0.50 - 0.65	in-lb N·m kg-m
Inlet Manifold Mounting Bolts	43.2 - 54.6 4.9 - 6.4 0.50 - 0.65	in-lb N·m kg-m

[•]Loctite #242 required

No Manufacturer Special Tools are required.

General Equipment Required

Fuel Pressure Gauge, 0 - 15 psi [0 - 1 kg/cm•]
Tee Fitting with 3/8 in O.D. barbs [9.5 mm O.D.]
Torque Wrench, 0 - 150 in-lb [0- 17 N·m/0 - 1.7kg-m] Digital Pulse Tachometer Flexible Fuel Tubing, 3/8 in I.D. x 5 in. [9.5 mm I.D. x 127 mm]

Consumable Supplies Required

Thread Locking Compound, *Loctite* 272

Isopropyl Alcohol Cleaning Solvent Lint-free Wipes

Fuel System Requirements

Acceptable Fuel - Gasoline

Any gasoline with pump posted octane rating over 87 (research octane rating of 91) and with no more that 10% Ethanol by volume.

Acceptable Fuel – Heavy Fuels

JP-5/8; kerosene; diesel #2; are acceptable. It is critical to insert additive in 50:1 mix. 50:1 mix must be used in addition to the additive.

Unacceptable Fuel

Gasoline with more than 5% Methanol (even if it contains co-solvents or corrosion inhibitor) or more than 10% Ethanol, regardless of the octane rating.

Fuel Storage Life

Fuel of storage should not be used after a period of 3 months.

Acceptable Lubricant

Any NMMA certified TC-W3 2-cycle outboard engine oil is acceptable for fuel tank premix applications on gasoline. Do not use automotive oils which can damage the engine and shorten spark plug life. For Heavy Fuels (JP-5/8, kerosene, diesel) use additive (Mercury JP or Raider JP with additive).

Mix Ratios



A 25 : 1 gasoline/oil mixture is required during engine break in. Refer to Break-In Procedure in Section 2.

Gasoline Premixing

A 50:1 gasoline/oil mixture (2% oil) is required. New engines or reconditioned power heads require a 25:1 gasoline/oil mixture (4% oil) during break-in.

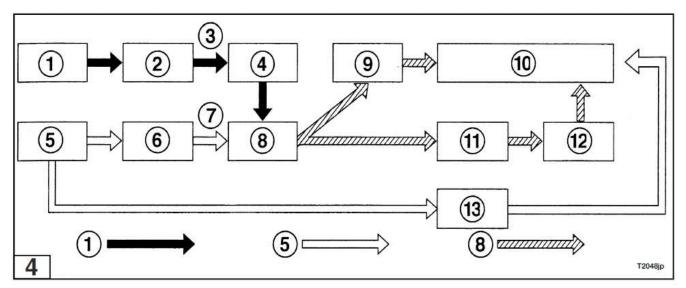
Heavy Fuel Premixing

A 50:1 Heavy Fuel Additive is required. Each container will support a 6 gallon bladder.

All mixing must be done prior to mission.

Fuel System Operation – Raider

Each step of the fuel entering the Raider 40 will be explained in this section.



Under idling conditions, the mixture of fuel and air is mainly output from the pilot outlet. As throttle is increased, the negative pressure applied to the pilot system increases and allows more of the mixture to flow from the bypass. When the throttle is opened further, the increase of air causes a pressure drop which allows the main system to assume full control of fuel delivery.

Troubleshooting fuel issues

The troubleshooting chart lists common engine symptoms related to problems with the fuel system. It also indicates specific malfunctions in the fuel system which may be causing the problem so it can be isolated more effectively. Before beginning major troubleshooting operations on the fuel system, perform the following operations:

- Disconnect fuel tank hose from the engine. Connect a known good bladder and hose and determine if the problem persists.
- Remove and clean the engine fuel filter assembly and replace the filter element.
- Replace filter element in the fuel tank pickup tube.

Troubleshooting Fuel Issues

Symptom	Hard to start or will not start	Misses at low speeds	Misses at high speeds	Poor acceleration, hesitation or coughs	Runs rough and smokes	Idles well, then slows and stops	Will not start and after fires into exhaust housing	No acceleration, low/full throttle RPM	Idles well but slows when accelerated	Runs at high speed only when hand primer is used	Engine stops suddenly	Runs noisy and knocks	Excessive fuel consumption
FUEL TANK AND FILTERS													
Empty fuel tank	•										•		
Low fuel in tank		٠		٠									
Fuel tank air vent closed	•					•				•	٠		
Poor quality or old fuel	•	٠	٠		•								
Water in fuel system	•		•						•				
Fuel hose pinched or disconnected	•							•	•	•			
Restricted fuel pickup pipe or clogged pipe filter	•							•	•	•			
Faulty primer bulb	٠												
improper or faulty anti-siphon valve	•							٠	•	•			
Clogged fuel filter	٠							•	٠	•			
Loose connector or vacuum leak	•								٠				The second secon

Oil and Fuel Induction (Carburetor)

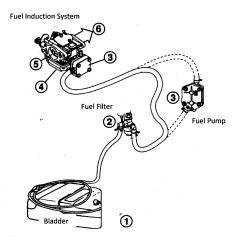
Symptom	Hard to start or will not start	Misses at low speed	Misses at high speed	Poor acceleration, hesitation or coughs	Runs rough and smokes	idles well, then slows and stops	Will not start and after fires into exhaust housing	No acceleration, low/full throttle RPM	Idles well but slows when accelerated	Runs at high speed only when hand primer is used	Engine stops suddenly	Runs noisy and knocks	Excessive fuel consumption
	0	IL MI	XTUF	₹E	A1444		,		,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	,			
Mixture too rich (too much oil)		•			•								
Mixture too lean (not enough oil)						•		•	•			•	
	C/	RBU	RETO)R		f	L.,,,,,,,,	L					
Carburetor out of adjustment	•	•		•	•			•	•	•			
Carburetor obstruction or faulty needle valve	•												
Restricted air flow to carburetor					•								
Faulty choke valve	•				•								
Carburetor and ignition timing not synchronized	•							•					
Float position too high					•								•
Float position too low				•					•	٠			
Jet obstructed or defective				٠						•			•
Carburetor gasket leakage				•									•

Troubleshooting Recirculation, Fuel Pump, Inlet Manifold

Symptom	Hard to start or will not start	Misses at low speed	1	Poor acceleration, hesitation or coughs	Runs rough and smokes	Idles well, then slows and stops	Will not start and after fires into exhaust housing	No acceleration, low/full throttle RPM	Idles well but slows when accelerated	Runs at high speed only when hand primer is used	Engine stops suddenly	Runs noisy and knocks	Excessive fuel consumption
1	REC	<u>IRCUI</u>	<u>LATIO</u>	N									
Puddle drain valve or hose blockage		•			٠	•							
Recirculation hose misrouted		٠		•									
	F	UEL	PUM	P									
Mounting gasket leakage	T					٠				•			
Check valve sticking open or closed				•		·				•			
Ruptured diaphragm				•									•
	INLE	T M	ANIFO)LD									
Warped inlet manifold	T	•		•									
Manifold gasket leakage		•		•			***************************************						
Faulty reed valve operation or broken valve		٠		٠				•				1	
Reed valve gasket leakage	Ī	٠		•			•	•					

Raider – Description of Operation

Upon engine startup, premixed fuel is drawn from fuel tank (1) by vacuum pressure on the suction side of the fuel pump through the fuel filter (2) and, into fuel pump (3). Fuel flows from the fuel pump into the Fuel Induction chamber (4). Fuel is drawn from the fuel induction metering rod into the FIS (5) where it is mixed with a ir and pulled into the crankcase (6).



Fuel Pump [3] above

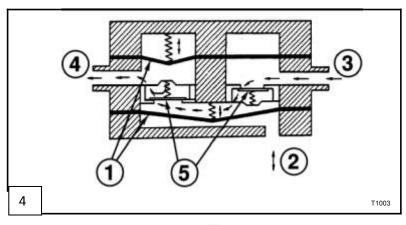
The fuel pump is integral with the Fuel Induction Unit and mounted on the side of the crankcase and contains one or more internal diaphragms (1). The diaphragms move in response to changing crankcase pressures (2) which draws fuel in (3) and pumps fuel out (4). A series of check valves (5) in the pump ensure that fuel moves only in one direction.

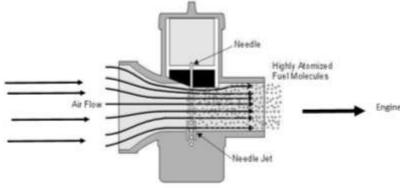
Fuel Induction System (FIS) [4] above

The FIS use a pilot system and main system to meter and deliver an atomized fuel mixture to the engine for combustion under varying operating conditions.

Fuel Induction System operating system

The operation of the FIS is shown below.





Single Point Fuel Pickup (No Jets) Extremely High Atomization

Altitude Compensation Low HC and CO Emission

Main System

The main system in the carburetors is a high speed system consisting of the main jet, main nozzle and main air jet. As the throttle valve opens, mixed fuel (14) enters the carburetor and flows from the carburetor float chamber (15) to main jet (16). The fuel is then measured and directed to the main nozzle (17) bleed hole where it combines with air (18) from the main air jet (19). The increased air quantity and flow rate at venturi (22) allows pressure drop at the tip of main nozzle (20), causing increased output of fuel/air mixture (21). The fuel mixture combines with main air at the venturi (22) before entering the engine (23).

Recirculation

Recirculation hoses at the inlet manifold and crankcase re-circulate unburned fuel for engine consumption.

Fuel Bladder Connection

Fuel bladder connectors need to change over from MARS OMC to a new improved snap on connector. A male fuel connector should be used.

Cleaning

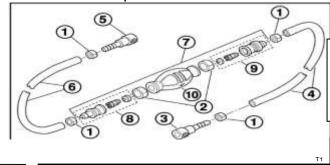
Water or dirt in the fuel bladder can cause fuel starvation and engine problems. Clean and inspect fuel bladder once a year or after long timestorage (more than 3 months).

- 1. Disconnect fuel line from fuel bladder.
- 2. Empty remaining fuel from bladder and properly dispose.
- 3. Fill tank 1/4 with fresh gasoline and install cap. Rigorously shake tank for 30 seconds to loosen dirt particles.
- 4. Empty gasoline from tank and properly dispose.
- 5. Inspect tank components before refilling.

Inspection

All worn, damaged, or missing parts must be replaced.

Fuel Line Description



5-Bladder connection to Raider See Parts and Assembly Manual R40 ES-001-15-2 for part numbers.

- 1. Clamp P/N 332702010M
- 2. Clamp P/N 3C7702170M
- 3. Fuel Connector to Bladder P/N 3B2702810M
- 4. Fuel Hose 7MM (5/16") Use fuel line material
- 5. Fuel Connector Engine side female P/N 3B2702501M
- 6. Fuel Hose 7MM (5/16")
- 7. Complete Assembly No Part No. available
- 8. Joint Assembly outer P/N: 3C7702241M
- 9. Joint Assembly inner P/N: 3C7702201M
- 10. Primer Bulb P/N 3C7702111M

*MALE QUICK CONNECTOR

The connector that should be inserted into Fuel Bladder is Part Number 9999800MA2 is the complete fuel line assembly that can be cut and inserted in the fuel bladder (1/4 inch NPT).

Fuel bladder is connected to the engine by a hose with a primer bulb. The primer bulb forces fuel into the Fuel Induction System for engine starting. Check valves on each side of the primer bulb maintain fuel flow, in one direction only, from the tank to the engine.

Disassembly

NOTE

Direction of fuel flow as indicated by the arrow on the primer bulb.

- 1. Remove and discard hose clamps (1) and primer bulb clamps (2) as required.
- 2. Remove tank connector (3) and hose (4).
- 3. Remove engine connector (5) and hose (6).
- 4. Remove primer bulb assembly 7. Remove check valves
- 5. (8) and (9) from primer bulb (10).

Cleaning and Inspection

- 1. Clean components using soap and water.
- 2. Dry all components with low pressure compressed air. Make sure all parts and passages are completely dry. Inspect primer bulb and hoses for cacks and deterioration.
- 3. Inspectbladderandenginequick connectors for damage andwear. Make sure check valves in quick disconnects open freely when pressed.
- 4. Inspect primer bulb check valves for damage.
- 5. Reassemble all components.

In-Line Fuel Filter Replacement

NOTE

In-line fuel filters cannot be serviced. Replace in-line fuel filters once a year or with each tune-up. When replacing an in-line fuel filter, note direction of fuel flow as indicated by the arrow on the filter housing for proper installation.

- 1. Loosen clips (1) on each side of the filter (2) and slide down the hose.
- 2. Separate the fuel filter from the hoses and discard.
- 3. Replace with new filter
- 4. Attach hoses and secure clips

A CAUTION

Before servicing the fuel pump, disconnect the fuel hose from the engine to prevent excessive spillage.

Disassembly – Fuel Pump

NOTE

Match mark parts before disassembly and reference the illustrations in the Inspection procedure to ensure proper orientation of internal components.

Expand and move clips (1) on fuel hose(s) (2).

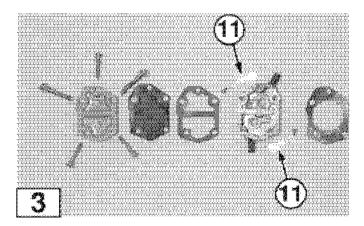
Disconnect fuel hoses from fuel pump.

Loosen pump mounting screws (3) and remove fuel pump (4) and gasket from crankcase.

Remove fuel pump cover screws (5) and cover (6). Gently separate the pump components.

Remove all check valves (11) from pump body.

Remove and discard all serviceable gaskets and diaphragms



Cleaning

- 1. Clean all pump components with kerosene.
- 2. If necessary, clean pump mounting surface on FIS with isopropyl alcohol.
- 3. Dry all components with low pressure compressed air.

Inspection

Inspect pump body (1) for cracks.

Inspect check valves (2) for deformation.

Inspect pump covers (3) for cracks and surface deformation.

Inspect guide plate (4) and spring (5), if equipped, for deformation and tension. Inspect gasket between crankcase and fuel pump for dryness (crankcase-mounted

pumps).

Assembly

- 1. Install all check valves in pump body.
- 2. Fully assemble fuel pump. All serviceable gaskets and diaphragms must be replaced.
- 3. Install fuel pump. Use Loctite 242 on mounting screw threads.
- 4. Connect fuel hoses to fuel pump.

Fuel Induction System

The fuel induction System looks like a carburetor however is much different. Air flows into the FIS through a venture system that increases flow. That air flow, via a metering rod and harmonics breaks the fuel into a fine mist – just like direct injection. The droplets allow for better fuel burn which increases power and extends mileage.

When burning heavy fuels (JP-3/5/8, kerosene, and diesel) three settings are defined in the User's Manual.

The FIS compensates for altitudes with no modifications

Removal

- Remove motor cover.
- 2. Disconnect fuel supply.
- 3. Removefuelhose from FIS.
- 4. Loosen clamp bolts and remove Fuel Induction unit.

A CAUTION

Use the following precautions during Fuel Induction disassembly

- 1. Clean plastic parts with warm soapy water.
- 2. Dry all components with low pressure compressed air.
- 3. When drying passages, direct the flow of air opposite the direction of fuel flow.

4. DO NOT inspect passages or holes with wire or similar materials. Doing so may scratch or enlarge jet holes and alter the fuel-air ratio.

NOTE

Before inspection, all fuel induction components must be cleaned. All worn or damaged parts must be replaced.

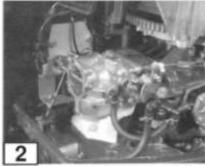
Reed Valve

Disassembly

- Follow steps listed in Carburetor Removal procedure, this section.
- 2. Disconnect the linkage at the throttle cam.
- Remove the crankcase recirculation hose from the manifold.
- 4. Remove recoil starter or flywheel cover as applicable, refer to Powerhead section.
- 5. Remove the intake manifold.
- 6. Remove the reed valve assemblies from the manifold or lift them from the crankcase as applicable. DO NOT disassemble the reed valve assemblies. (Except 8/9.8)

Inspection

- 1. Inspect the reed valve assemblies:
- All gasket surfaces must be flat, within ± 0.003 in [0.08 mm].
- . Inspect reeds (1) for cracks or chips. Reeds must be seated flat without any preload.
- · Check tightness of reed valve stoppers (2). If loose, tighten screws using Loctite 242.
- · Inspect valve seat surface (3) for rise, wear, or damage.







Lift height of each reed valve and stopper must meet specification.

Reed Valves Raider

	40
No. Valves	12
Strips Valves/Strip	4 Strips
	3 Valves/Strip
A=Valve	0.236-0.244 in
Height	(6.0-6.2 mm)

B=Gap Valve End Valve Seat	
2 Sup ruits 2 in ruits Sout	0.0079 in
	(0.2 mm)
	,

· Inspect entire valve assembly

If any part of the reed valve assembly is worn, damaged, or corroded, entire valve assembly must be replaced.

CAUTION

Used reeds must never be turned over and re-used. Reed could break when returned to service, causing serious powerhead damage.

2. Inspect the intake manifold:

All gasket surfaces must be smooth and free of nicks

Check manifold surface for flatness in all directions. Mounting surface must be flat, within \pm 0.004 in [0.10 mm].

NOTE

All intake manifold components must be perfectly clean before assembly. Use isopropyl alcohol. DO NOT use a carburetor cleaner or a soaking tank.

Never reinstall the used reed valve screws because the effect of the adhesive has been lost and may Lead to reed valve failure during operation.

Verify that the clearance between the reed valve and the valve seat is 0.0078 inches (0.2 mm) or Less after assembly.

- 7 1. Assemble the intake manifold components as illustrated:
- · Install all gaskets dry.
- Torque manifold bolts evenly to specification.
- Connect the crankcase recirculation hose to the manifold.
- Follow steps listed in Carburetor Installation procedure, this section.
- 4. Connect the linkage at the throttle cam.
- 5. Install recoil starter or flywheel cover as applicable, refer to Powerhead section.

SECTION 4 - POWERHEAD

General Precautions

Before performing any service work on the powerhead, read and understand the Service Safety section at the beginning of this manual.

Use the manufacturer special tools as indicated during servicing of the powerhead.

Use caution when performing tests with the engine cover removed. Do not wear loose clothing or jewelry. Keep hair, hands, and clothing away from the flywheel.

Check entire fuel system for leaks after servicing the powerhead to prevent fire or explosion.

Make sure all ignition and electrical leads are properly routed and clamped in their original positions.

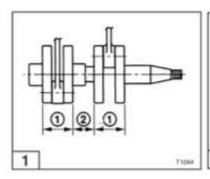
Disable the ignition system and disconnect the battery when servicing the powerhead.

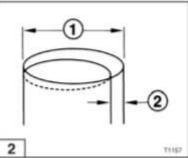
Replace locking fasteners when their locking feature becomes weak. Use only factory replacement parts.

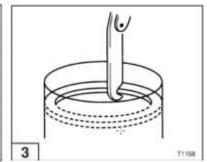
Always inspect and test the start-in-gear prevention system before returning engine to customer.

Service Specifications - (Standard Value)

Fig	Description		Unit	Raider 40
	Compression		psi kPa kg/cm•	106.6 735 7.5
	Thermostat Opening Temperature		OF OC	125.6 52
	Crankshaft (off center)		in mm	<0.002 <0.05
	Crankshaft (dimensions)	1	in mm	2.071 ±0.002 52.6 ±0.05
1		2	in mm	1.591 ± 0.002 40.4 ± 0.05
2	Cylinder Bore	1	in mm	2.756 70
2	Piston Clearance	2	in mm	0.0024 - 0.0039 0.05 - 0.10
3	Piston Ring End Cap		in mm	0.008 - 0.016 0.20 - 0.40







Manufacturer Special Tools Required

Flywheel Puller Assembly, 336-72214-0 Flywheel Stripper, 386-72214-1 Piston Pin Tool, 332-72215-0 Piston Ring Tool, 353-72249-0 Thickness Gauge Set, 353-72251-0

General Equipment Required

Compression Gauge, 0 - 199 psi [0 - 1,350 kPa / 0 - 13.7 kg/cm²]

Water Pressure Gauge, 0 - 15 psi [0 - 98 kPa / 0 - 1 kg/cm²]

Torque Wrench, 0 - 150 in-lb [0 - 17 N-m / 0 - 1.7kg-m]

Torque Wrench, 0 - 750 ft-lb [0 - 1000 N-m / 0 - 100 kg-m]

Micrometer Set or Vernier Caliper, graduation 0.0001 in [0.01 mm], 0 - 1 in [0 - 30 mm] range Telescoping Gauge, Inside Micrometer Set, or Vernier Caliper, graduation 0.0001 in [0.01 mm], 1.5 - 4 in [40 - 100 mm]

Dial Indicator, graduation 0.0001 in [0.01 mm], 0 - 1 in [0 - 30 mm] range

Analog Multimeter, Electronic Specialties® Model M-530 or equivalent

Digital Pulse Tachometer, 10 - 6000 RPM, *Electronic Specialties® Model 321 or equivalent* Industrial Thermometer, minimum 300°F [150°C]

Heat-Resistant Container, Pyrex®

Bearing Puller

Seal Pullers

Seal Installer

Surface Plate, 20 x 20 in [500 x 500 mm], 0.0001 in [0.01 mm] accuracy

Consumables Required

Threadlocker, Loctite® 242

Threadlocker, Loctite® 243

Gasket Dressing, Permatex® Hylomar® Aerosol High-Temp Gasket Dressing

Gasket Sealant, Permatex® High Tack Gasket Sealant

Anaerobic Gasket Maker, Loctite® 518

Dielectric Lubricant, Permatex® Dielectric Tune-Up Grease

Troubleshooting – Power Head

The troubleshooting chart lists common engine symptoms related to problems with the powerhead. It also indicates specific component failures which may be causing the problem so it can be isolated more effectively.

Symptom	Hard to Start Or Will not start	Low Comp- ression	Runs Rough or Erratically	Idles Poorly	full	RPM De- crease	Engine Over- heats	Runs Noisy Excess. Vibrati on
Poor crankcase seal	•							
Ignition timing or throttle linkage out of adjustment, see Section 2	•		•		•			
Water entering crankcase	•			•		•		
Defective thermostat					•		•	
Fouled, defective or incorrect spark plug; wrong gap setting	•		•	•		•	•	
Worn or defective cylinder, piston,rings or warped head	•	•			•			•
Blown cylinder head or engine base gasket	•	•	•	•	•	•		•
Worn connecting rod or crankshaft bearings, internalwear limits out of specification	•		•					•
Defective ignition components, see Section 7	•		•		•			
Carbon accumulation in combustion chamber	•				•	•		

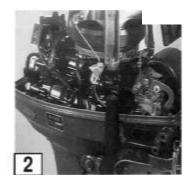
DESCRIPTION OF OPERATION

The power head of this outboard motor is a twostroke engine (or two-stroke cycle engine). The engine completes its one cycle operation including gas mixture suction, compression, explosion and exhaust while the crankshaft rotates once i. e. the piston moves upward and then downward (two strokes).

As the piston starts to move toward top dead center (TDC), the interior of the crank case is made vacuum pressure causing the reed valve to open and the gas mixture to be taken into the crankcase. As the piston comes near the TDC, the spark plug produces the sparks to ignite the compressed gas mixture for combustion. As the fuel mixture is exploded, the piston moves toward bottom dead center (BDC) and open the exhaust port and then scavenging port. The scavenging is an action that sends the fresh gas mixture in the crankcase to the cylinder.



1



The Raider outboards are unusual from commercial outboards; the head of the Raider has included two dewatering valves that allow water to escape after submersion – when opened. The heads have also been modified to allow more water flow which keeps the engine cooler that will increase reliability and life of the Raider.

Cylinder Compression Test

- 1. Operate engine to normal operating temperature.
- 2. Stop engine.
- 3. Disconnect the magneto leads to disable the ignition system.

⚠ MARNING

Ignition system – battery must be disabled to prevent accidental engine start up.

- 4. Remove spark plug(s) and install thread-type compression tester in spark plug hole.
- 5. Place throttle in fully open position and crank engine with starter through at least four compression strokes.
- 6. Take reading for each cylinder and verify specified pressure is obtained:

Raider	Cylinder Compression* psi [kPa/kg/cm2]
40	106.6 [735.0 <i>[</i> 7.5]

*Compression variation among cylinders should not exceed 15 psi [103 kPa/1.05 kg/cm2] on two cylinder engines.

If variation of cylinder compression, on two cylinder engines, exceeds 15 psi [103 kPa/1.05 kg/cm2], check for the following:

- · Scored cylinder walls.
- · Piston damage.
- Head gasket damage.
- Stuck or broken piston rings.

On two cylinder models, if cylinder compression is equal, engine is difficult to start and runs poorly, checkforthe following:

- Scored cylinder walls.
- · Piston damage.
- Stuck or worn piston rings.

Thermostat

Removal

- Remove thermostat cap screws. Gently tap thermostat cap
 (3) with rubber mallet to loosen and remove cap and gasket.
 - Discard gasket.
- 2. Remove thermostat and inspect for obvious damage and corrosion.
- 3. Check pressure relief valve for proper operation.
- 4. Perform thermostat Function Test if thermostat is suspect.

Installation

Install thermostat in cylinder head.

Lightly coat both sides of new thermostat cap gasket (1) with gasket sealant. Mount gasket on cap (2).

Install thermostat cap and gasket and torque to specification.

Function Test

Suspend thermostat and thermometer in a heat-resistant container filled with water.

Slowly heat and stir the water. Verify the thermostat opens at 140°F 60°C If it does not open at specified temperature, replace thermostat.

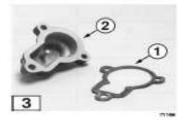
$\triangle \triangle$ WARNING

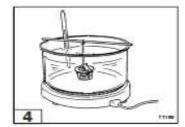
Use a heat-resistant container such as Pyrex® glassware. DO NOT allow Thermostat or thermometer to rest against the glass. Items could overheat and rupture.

 Remove thermostat and observe its closing action as it cools. If closing action is not slow and smooth, replace thermostat.









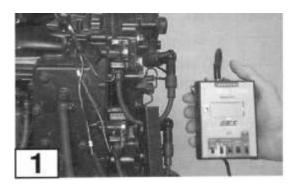
RPM Performance Test

A CAUTION

Do not perform RPM test if engine shows signs of overheating.

Perform this test with correct test propeller Installed and with the engine in a test tank.

- 1. Operate engine up to normal operating temperature.
- 2. Stop engine and install tachometer.
- 3. Start and run engine at NEUTRAL idle and verify specified RPM is obtained.
- 4. If test tank conditions permit, run engine in forward gear attrolling and full throttle speeds and check for correct RPM:



Raider 40	NEUTRAL RPM	Trolling Speed RPM	I Throttle Speed RPM
	950	850	5200-5800

If test results vary, refer to Troubleshooting in this section.

Recoil Starter

⚠ WARNING

The Raider 40 engines have neutral start mechanism (start-in-gear protection) attached to the recoil starter. This feature disables the engine from starting while in gear (forward or reverse). During reassembly of the engine following repair, ensure that you DO NOT DISABLE THE START-IN-GEAR PROTECTION.

⚠ MARNING

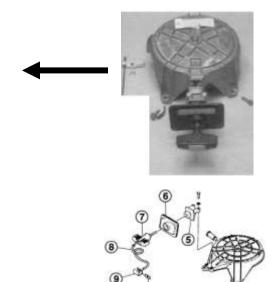
Ignition system must be disabled to prevent accidental engine startup during servicing of the recoil starter.

Removal for Emergency Operation

Using the tools found in the Emergency Tool Kit; use the socket that has 10 mm on one side and 13 mm on the other end.

- 1. Remove the neutral start mechanism components and remove the recoil starter unit from the engine.
- 2. Rewind the reel and loosen the recoil starter spring.
 Use a screw driver to put the starter rope in the reel notch. With the rope hooked in the notch, rotate the reel slowly to loosen the rope.
 Repeat this process until the starter spring does not pull the reel.
- 3. Remove the handle from the starter rope (8).





4 . Remove ratchet e-ring (7), ratchet (5), ratchet guides A and B (8) and (9), starter shaft bolt (14), starter shaft (11) and finally the reel.

Cleaning and Inspection

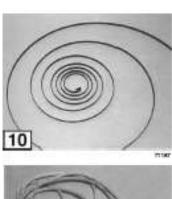
All worn, damaged, or missing parts must be replaced.

- Clean metal parts with solvent and dry with low pressure compressed air. Clean plastic parts with dry cloth
- 2. Inspect following components as follows:
- 3. Starter rewind spring for cracked or broken and loops.
- 4. Ratchet and reel stopper springs for deformation or poor tension.
- 5. Sliding plates, stopper components, and busing for cracks or signs of wear.
- 6. Reel assembly for wear.
- 7. Starter housing for sharp or rough edges which could fray starter rope. Starter rope for frays and rope handle for damage.

Assembly -

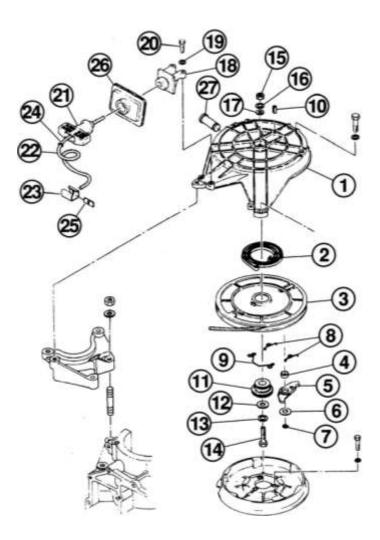
For assembling, use the procedure reverse to the disassembly while observing the following notes.

- When setting the starter spring (2) on the starter spring case (1), direct the outer edge hook of the coil spring to the right and set it in the notch of the starter spring case outer circumference.
- When winding the starter spring (2), rotate the reel (3) to the direction of turn (left turn) at pulling out the rope. Then, set the spring so that the reel rotates 1/4 of a turn to one and 1/4 of a turn when rope is fully pulled out.
- Apply anti-freeze grease to both ends of the starter spring (2) and sliding area between the starter shaft bolt (14) and friction plate.
- Tighten the starter shaft bolt to the specified toque.

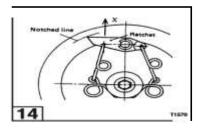




Pull Starter Diagram



- Install the starter locking rod, the starter locking cam shaft and the starter handle.
 Verify that the ratchet operates when the proper load is applied to the ratchet.
 Set ratchet face up, apply grease and measure force.



Ratchet Load Re	equirements
40:	300 to 500 grams

Flywheel

NOTE

Flywheel magneto must be of a particular strength in order to run the ignition system. Flywheels seldom go bad and would only be replaced as a last resort in solving an ignition problem.

CAUTION

Flywheel is under high torque and requires the use of special tools for removal and installation. Failure to use the specified tools can result in injury or damage to the flywheel or coil plate electrical components.



CAUTION

The force needed to loosen and tighten the flywheel nut requires flywheel be removed and installed with engine mounted and secured on an engine stand.

NOTE

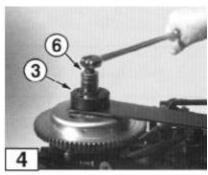
Reference the following specification table for flywheel Removal and Installation special tool requirements.

Wheel Puller Part Number: 211-0 (336-72214-1) for Raider 40 Outboard

⚠ MARNING

Ignition System must be disabled to prevent accidental engine startup during removal of the flywheel.

- 1. Remove recoil starter and starter pulley
- 2. Determine the direction of rotation for removing flywheel nut by running your thumbnail along the threads of the crankshaft.





Inspection

- Inspectflywheel for cracks, chips, and damaged taper. 1.
- 2. Inspect crankshaft for thread damage and damaged taper.
- 3. Inspect flywheel key and keyway for damage.

Installation of Flywheel

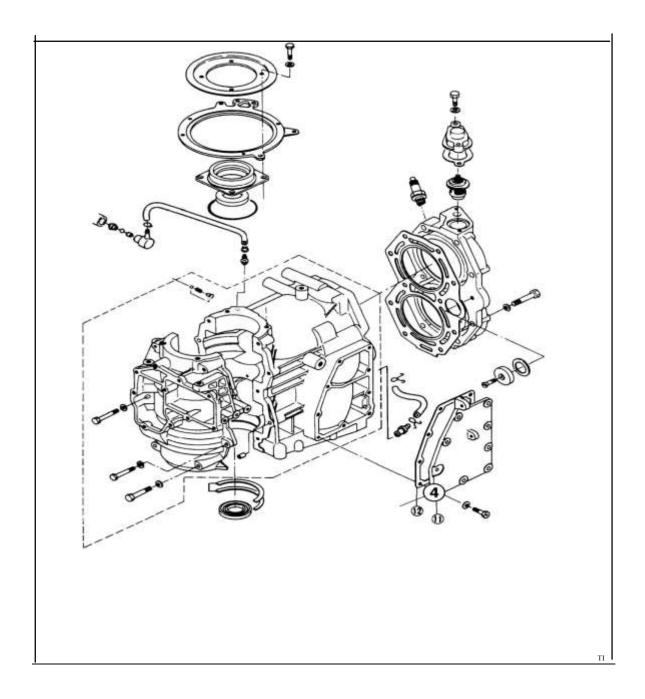
⚠ MARNING

Ignition system must be disabled to prevent accidental engine startup during installation of the flywheel.

- 1. Remove all grease from tapered portion of flywheel and crankshaft with solvent.
- 2. Check flywheel key is inserted in crankshaft.
- 3. Alignflywheel keywayand install oncrankshaft.
- 4. Install the flywheel washer. Install puller arm (1) on flywheel using bolts (2).
- 5. Hold puller arm and torque flywhee I nut to specification.
- 6. Install recoil starter.

Model	Flywheel Torque
Raider 40	1043 - 1217 in-lb 118 - 137 N-m 12 - 14 kg-m

Raider Engine Block – 2 Cylinder/2 Stroke



Removal of Raider Engine

⚠ MARNING

Ignition system must be disabled during removal of the powerhead.

NOTE

If service work requires flywheel to be removed, remove flywheel before lifting powerhead from the rest of the engine. See Flywheel, this section.

NOTE

Mark the mounting location of all clamps so they can be returned to their original positions during assembly of the powerhead.

- 1. Disconnect the battery and fuel tank.
- 2. Disable the ignition system and disconnect the battery terminals on the power head
- 3. Disconnect all electrical connections
- 4. Disconnect fuel INPUT hose from fuel filter.
- 5. Disconnect pilot water hose from exhaust cover.

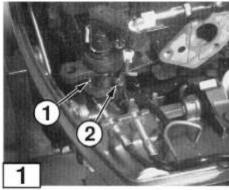
Complete the following operations.

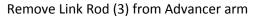
- Remove link rod (3) from advancer arm
- Disconnect shift cable from shift arm.
- Disconnect throttle cable from advancer arm.

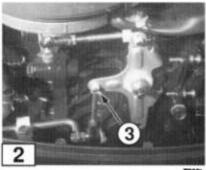
Remove engine mounting bolts.

Rock engine back and forth to break seal, then remove the powerhead by lifting straight up.

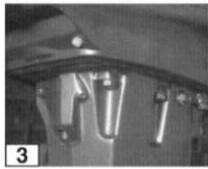
Remove lower crankcase head bolts (4). Insert screwdriver in pinch groove and remove lower crankcase head.





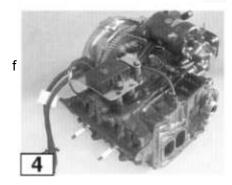


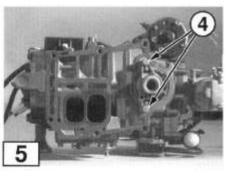
Remove bolts from outside holding Raider powerhead.



- 7. Remove engine mounting bolts.8. Rock engine back and forth to break seal, then remove the powerhead by lifting straight up.

 9. Remove lower crankcase head bolts (4)
 . Insert screwdriver in pinch groove and remove lower
- crankcase head.





Disassembly - Power Head

- 1. Remove all Fuel Induction System (carburetor), ignition, and electrical components from the powerhead.
- 2. Remove the intake manifold and reed valves. See Intake Manifold in Section 3.

NOTE

The reed valve of the single cylinder models is attached directly to the crankcase. Therefore, it is removed after dividing the crankcase.

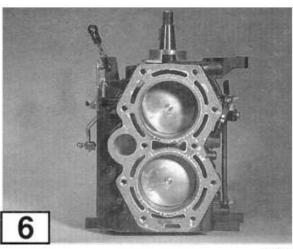
Cylinder Head

- 3. Remove and inspect the thermostat. See Thermostat, this section.
- 4. Remove the cylinder head bolts. Separate and remove cylinder head.
- 7

NOTE

Start with those farthest from the center of the cylinder head and work inward.

5. Using a pointed scribe, identify the heads of the cylinders for correct positioning during assembly operations.









Inside view of Raider 40 Powerhead

- 1. Look for any damage
- 2. Replace gasket
- 3. Use Permatex Aviation gasket cement when assembly

8 9 6. Remove the exhaust cover bolts. Insert screwdrivers into pinch grooves to separate and remove outer and inner exhaust covers.

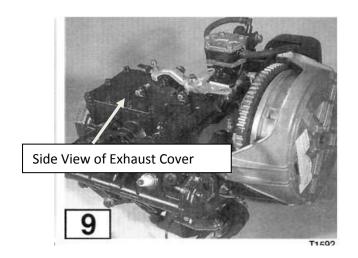
Crankcase and Crankshaft

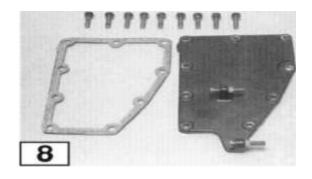
- 7. Remove and discard oil seal (1) and o-ring (2) from lower crankcase head (or engine base or lower cowl). Use a seal puller to prevent damage to the head.
- 8. Remove the crankcase bolts and separate the crankcase from the cylinder block.

NOTE

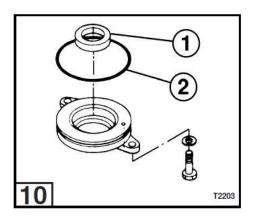
Start with the bolts farthest from the center of the crankcase and work inwald.

- 9. Tap the tapered portion of the crankshaft (3) with a rubber mallet to loosen it. Lift the crankshaft and pistons from the cylinder block and place on bench for disassembly.
- 10. Slide the upper main bearing off the crankshaft. Remove and discard bearing oil seal (4) and o-ring (5).

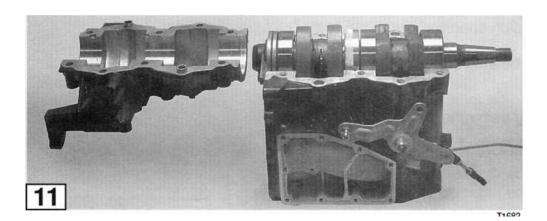




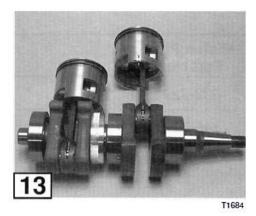
8. Exhaust Cover. Remove (9) cover bolts. Insert screwdriver into pinch grooves to separate and remove.

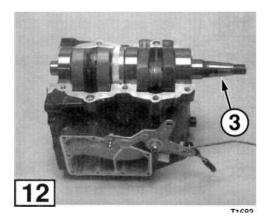


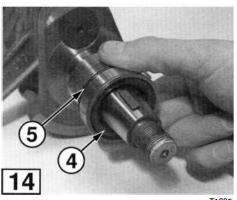
Remove Replace Oil Seals



64





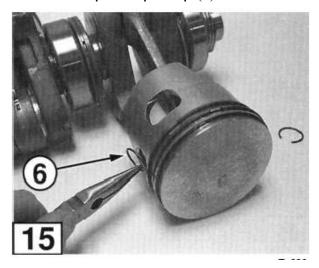


Pistons

NOTE

Pistons, rings, and connecting rod bearings are wear parts which seat with operation of the engine. Make sure these parts are marked and kept together so they can be returned to their original positions during assembly.

15. Remove piston pin clip (6) from both sides of each piston. (Discard the clips).

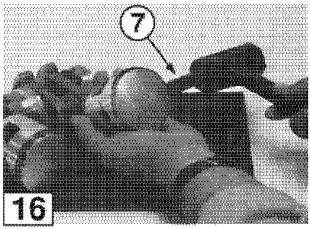


16. Tap out the piston pins using specified piston pin tool (7).

Piston Pin Tool Part Number	Raider
345-72215-0	40

15. .

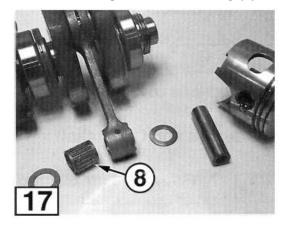
16 Remove each piston ring using the piston ring tool (Part No. 353-72249-0).



NOTE

Identify each ring so it can be returned to its original piston and ring groove.

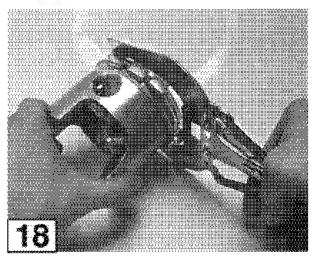
17. Remove the piston and bearing (8) from the connecting rod



14. Remove each piston ring using the piston ring tool (Part No. 353-72249-0).

NOTE

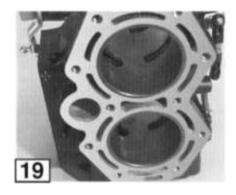
Identify each ring so it can be returned to its original piston and ring groove.



Cleaning

 Remove all carbon accumulation from exhaust port areas and cylinder head combustion chambers.

2. Use gasket remover and Scotch-Brite Abrasive Pads to remove all traces of gasket and sealer from the cylinder block, crankcase, cylinder head, intake manifold, exhaust covers, and air silencer.



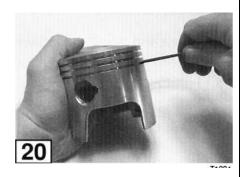
♠ CAUTION

DO NOT use a metal scraper on gasket surfaces or the mating surfaces of the crankcase.

3. Remove all carbon deposits from the tops and ring grooves of the pistons.

NOTE

A ring groove cleaning tool can be made by breaking an old ring and grinding an ang/e on its end. Do not damage the grooves when cleaning.



- 4. Wipe off all traces of oil and thoroughly wash the cylinder block and crankcase with warm, soapy water. Air dry the cylinder block and crankcase. Dry all holes and passages with low pressure compressed air.
- Coat the cylinder walls with genuine engine oil or certified TC-W3 oil to protect them from corrosion.

Inspection

NOTE

Before inspection of the powerhead, all components must be perfectly clean and free of contaminants.

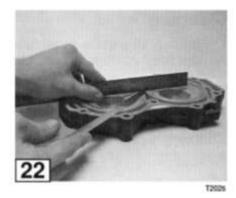


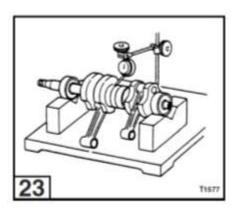
T1690

⚠ CAUTION

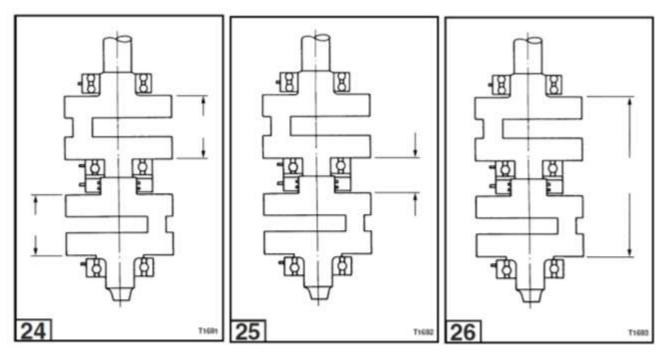
After the inspection, when it is found that the cylinder(s) requires re-finishing or boring, all the works have to be done in the approved machining plant. Light scuffing or burn does not require boring for removal. Use water-resistant sand paper of around #320 to remove the damages, and then use #400 and #600 to finish.

- 1. Visually inspect all internal components. Inspect for unusual wear patterns, heat-related discoloration of bearings, broken parts, and scuffing or damage to aluminum parts.
- 2. Inspect the intake manifold and reed valves. See intake Manifold Section 3.
- 3. Check the cylinder head for warpage using a machinist straight edge and the thickness gauge set (Part No. 353-72251-0). If warpage exceeds 0.004 in [0.10 mm], replace the cylinder head.
- 4. Using an accurate dial indicator, measure the crankshaft deflection with the upper and lower main bearings installed. Measure as follows:
- Support both ends of the crankshaft at the main bearings in precision V-blocks or an alignment jig.
- Slowly rotate crankshaft and record measurement at each crankshaft bearing (1) and at both ends of the crankshaft.
- If deflection is more than 0.002 in [0.05 mm], replace the crankshaft.
- Measure and record the following crankshaft dimensions and check for signs of wear:
- Dimension 1: Distance between the outside edges of each pair of cranks haft webs. Measure at both ends of the webs.
- Dimension 2: Distance between each pair of crankshaft webs.





Dimension 3: Distance between the outside edges of the first and last crankshaft webs.



Model	Dimension 1	Dimension 2	Dimension 3
	in [mm]	in [mm]	in [mm]
40	$2.071^{+0}_{-0.002}$ $[52.6^{+0}_{-0.05}]$	1.591 ± 0.002 [40.4 ± 0.05]	5.733 [145.6]

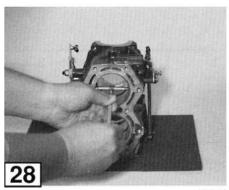
- 6. Check for smooth operation of all crankshaft and connecting rod bearings. Upper and lower main bearings and small end connecting rod bearings are serviceable. Wear of other parts requires replacement of the crankshaft assembly. If lower main bearing (2) is defective, proceed to remove the components as follows:
- Remove snap ring (3).
- Install a universal bearing puller with bearing retainer plate and remove lower main bearing (2) from the crankshaft.
- See powerhead Assembly procedure for installation.

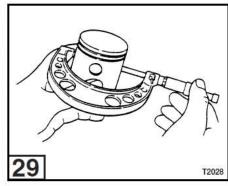
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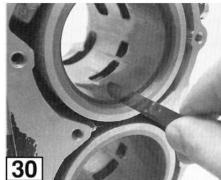
T202

NOTE

DO NOT fully disassemble the crankshaft assembly unless further wear or damage is suspect.







T122

7. Measure and record the diameter of each cylinder bore and the outside diameter of its respective piston. Subtract the values to calculate the piston clearances. If any bore diameter or piston clearance exceeds the specified limit, the cylinder must be professionally bored oversize for use with an oversize piston.

Model	Standard	Standard	Repair Limit
	Bore Diameter	Piston Clearance	Piston Clearance
	in [mm]	in [mm]	in [mm]
40	2.76 [70]	0.0020 - 0.0039 [0.05 - 0.10]	0.006 or over [0.15 or over]

- 8. Complete the following inspection for new or used piston ring sets. Inspect each ring separately:
- Place ring in its respective cylinder bore.
- · Use a piston to square the ring in the bore.
- Use the thickness gauge set (Part No. 353-72251-0) to measure the ring end gap.

The ring end gap must be within specification:

Model	Standard Ring End Gap in [mm]	Repair Limit Ring End Gap in [mm]	
40	0.08 - 0.019 [0.33 - 0.48]	0.031 [0.8] or over	

Assembly

NOTE

Before assembly of the powerhead, all components must be perfectly clean and lightly coated with genuine engine oil or a NMMA certified TC-W3 oil. All serviceable gaskets and seals must be replaced.

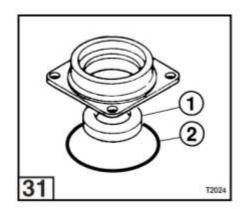
Preliminary

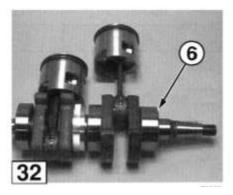
1. Before installation, lightly coat the outside surfaces of new bearing seals and o-rings with genuine engine oil or TC-W3 oil. Apply bearing cup grease to the seal lips. Press fit the seals into place using an appropriate size seal installer to avoid damaging the seal or component.

- Install a new oil seal in lower crankcase head and a new o-ring on base of lower crankcase head (or engine base or lower cowl).
- . Install new oil seal (1) in upper magneto base and new o-ring (2).
- Coat the rotating surfaces of the crankshaft and connecting rod bearings, bearing washers, and bearing thrust plates (model 40) with genuine engine oil or TC-W3 oil.



- 3. If upper main bearing was removed, slide and install the upper main bearing onto crankshaft (6).
- If lower main bearing was removed, coat lower end of crankshaft with genuine engine oil or TC-W3 oil and install the bearing.









Pistons

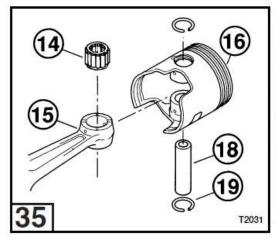
5. Install each piston ring in its original groove on its original piston using the piston ring tool (Part No. 353-72249-0). Each ring must be installed so end notches (11) fit the contour of piston knock (12) when the ring is compressed.

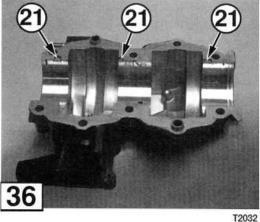
6. Install each piston on its respective connecting rod as follows:

NOTE

An arrow (13) or the word "UP" is cast on the top of the piston. This mark is used to align the piston in a specific orientation. See chart for proper orientation.

1000	of converse work and the second of the secon	
40	"Up" mark points to flywheel	





- 35 Insert bearing (14) into small end of connecting rod (15).
- 35 Correctly position piston (16) onto the connecting rod.
- Align components so piston pin hole is not obstructed and install piston pin (18) using piston pin tool.
- 35 Install new piston pin clips (19). Do not reuse old clips.
- Align components so piston pin hole is not obstructed and install piston pin (18) using piston pin tool.
- 35 Install new piston pin clips (19). Do not reuse old clips.

Cylinder Block and Crankcase

- 7. Coat the pistons, rings and cylinder walls with genuine engine oil or TC-W3 oil. Install the bearing washers or thrust plates (model 40) into cylinder block, guiding each piston into its respective cylinder. Ensure the following:
- All main bearing knocks (21) are seated against the crankcase mating flange of the cylinder block.
- Bearing washers or thrust plates (model 40) are seated properly in the cylinder block.

- 8. Degrease the crankcase flange and mating surface of the cylinder block. Apply anaerobic gasket maker(Loctite 518) to the cylinder block frange. The application must cover the flange evenly and not be excessive.
- 9. Install crankcase on cylinder block.
- 10. Install crankcase mounting bolts and torque to specification:

NOTE

Start with the bolts closest to the center of the crankcase and work outward.

Cylinder Head

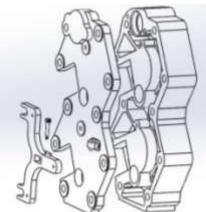
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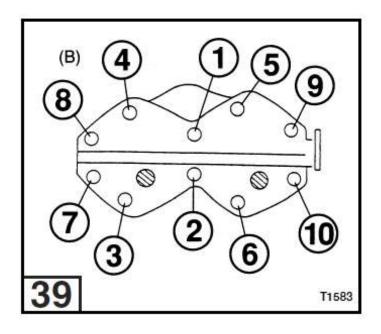
- 11. Head gasket requires adhesive. Recommended is Permatex Aviation cement. Install head gasket to Raider 40 outboard. Gasket is required between head and dewatering cover plate. Permatex Aviation cement is recommended. This gasket material does not harden like typical cement; excellent for submersion characteristics.
 - 12. Install cylinder head. Torque bolts to specifications.

<u>NOTE</u>

Start with bolts closest to the center of the crankcase and work outward.



Head Assembly with dewatering lever



40 13. Install thermostat and torque thermostat cap bolts to specification. See Thermostat, this section.



Thermostat located outside dewatering plate.

Exhaust Cover

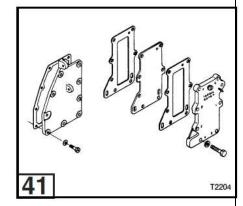
14. Lightly coat both sides of new (inner and outer) exhaust cover gaskets with gasket sealant. Install gaskets and mount exhaust covers to cylinder block. Torque exhaust cover bolts to specification from lowest embossed number to highest.

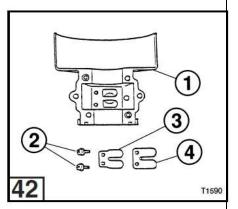
Final Assembly

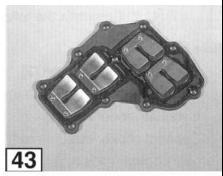
42 43 15. Install the reed valves and intake manifold. Check the reed valve and lift to verify setting. If damaged, replace with new assembly. See Reed Valve in Section 3.

16. Install all carburetion, ignition, and electrical components on the powerhead using the following guidelines. Assemble as much as possible before mounting powerhead to engine midsection.

- Follow all relevant procedures and wiring diagrams in other sections of this manual.
- Torque fasteners to specification. Use Loctite 243 on the pulsar coil assembly screws.
- Lubricate powerhead components as specified. See Lubrication Chart in Section 2.
- Route and clamp all wires and hoses away from moving engine parts.
- Do not install flywheel until powerhead has been bolted to engine base.
- 17. Install lower crankcase head.







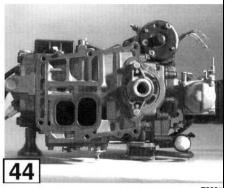
T161

19. Apply high temperature gasket dressing to engine base gasket and install gasket on powerhead.

Installation

1. Degrease the engine base surface and coat driveshaft splines (1) with genuine engine oil or TC-W3 oil.

2. Apply high temperature gasket dressing to bottom surface of engine base gasket. Lower powerhead onto engine base, guiding the driveshaft into the lower crankcase head.



- 3. Install the engine mounting bolts and torque to specification.
- 4. Connect fuel INPUT hose to fuel filter.
- 5. Connect pilot water hose to nipple.
- 6. Complete the following electrical connections:
- · Remote control or main key switch wire harness.
- Neutral safetyswitch.

Reference the appropriate wiring diagram in Section 7 for electrical box connections. Leave ignition system disabled.



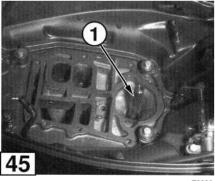
48 7. Complete the following operations.

Tiller models:

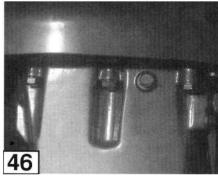
- Connect starter lock rod (2).
- Secure throttle cable (3) to throttle cable bracket (4).
- Install advancer arm (5).
- Connect choke knob link rod (6).

Remote control models:

- · Connect shift cable to shift arm.
- · Connect throttle cable to advancer arm.
 - Install flywheel and recoil starter (if equipped). See Flywheel and Recoil Starter, this section.
 - Perform all carburetor and ignition timing adjustments. See Synchronization and Linkage Adjustments in Section 2.
 - Perform all tune-up operations. See Tune-Up Procedure in Section 2.
 - 11. Test and inspect all safety features of the engine and instruct operator to repeat the original break-in procedure described in Section 2 before engine is put into normal service.



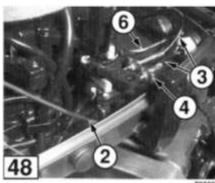
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T200

SECTION 5 – MIDSECTION

General Precautions

Before performing any service work on the midsection, read and understand the Service Safety section at the beginning of this manual.

Replace locking fasteners when their locking feature becomes weak. Use only factory replacement parts.

When using compressed air to clean or dry parts, make sure air supply is regulated not to exceed 25 psi [172 kPa / 1.76 kg/cm'].

Always inspect and test the start-in-gear prevention system before returning engine to customer.

Most service work on the midsection requires preliminary steps to remove major components. Follow all applicable procedures in other sections when indicated.

Use threadlockers and follow torque specifications as indicated to ensure shock-absorbing components remain secure after returning the engine to service.

Service Specifications Special Torque Values - Raider 40

Description		
	4 þ	Threadlocker
Bracket Bolt Nut (Tilt Tube Nut)	23.5 - 25.5 2.4 - 2.6	
Shift Lever Shaft Holder Bolt	41-55 4.6-6.3 0.47-0.64	Loctite 242

Required

Spring Pin Tool, 03 and 03.5: 345-72227-0, 345-72228-0, 369-72217-0, 369-72218-0

Rubber Mount Tool Kit- 40: 361-72760-0

General Equipment Required

Torque Wrench, 0-150 in-lb [0-17 N-m/0-1.7 kg-m] Torque Wrench, 0-145 ft-lb [0-200 N-m/0-20 kg-m] Dial Gauge, minimum scale 0.0001 in [0.01 mm]

Consumable Supplies Required

Threadlocker, Loctiteat 242
Threadlocker, Loctiteat 243
Gasket Dressing, Permatexat Hylomarat Aerosol High-Temp Gasket Dressing
Silicone Sealant, Permatexat Hi-Temp RTV Silicone
Gasket Super Bond Adhesive,
Permatexat Super Glue Gel
Cleaning Pads, Scotch-Brite® Abrasive Pads
Isopropyl Alcohol Cleaning Solvent Gasket Remover
Genuine Grease or Equivalent Friction Surface Marine Grease

Tiller Steering Handle -Raider 40

General Information

The tiller steering handle is used for steering, control throttle through a pinion throttle linkage.

The tiller is capable of lifting up the Raider. When two motors are controlled via a single tiller two additional elements must be added; (1) Cable from motor one to motor two; (2) Control rod that is placed in the back of each Raider. This option must be ordered in the initial sale.

For parts description use Raider Parts Assembly Manual; RPAM 40ES-001. Figure 1 shows tiller assembly.

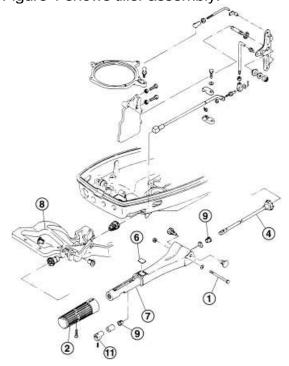


Figure 1. Tiller Assembly

3. Inspect all plastic and rubber bushings and spacers, grip (2), and friction piece (5) for cracks or deformation caused by wear.	
4. Check all fasteners for thread damage, all washers for deformation.	
2 3 4 5. Replace throttle label (6) if damaged or missing.	
1 2 3 4 6. Verify the following components and their friction surfaces are not cracked, bent, or wom: • Steering handle (7) • Steering bracket (8) 7. Inspect throttle cables (3) for kinks, wear, cracks in the protective covering, and excessive stretch.	
Assembly	Throttle subassemblies
Apply genuine grease or equivalent friction surface marine grease to bushings (9), spacer (11), and the grip portion of steering handle (7) before assembly. DO NOT lubricate friction piece (5).	
 Apply spray lubricant to the throttle cables. Work the cables back and forth to ensure full coverage under the protective covering. 	
2 3 4 2. Assemble all components onto throttle shaft (4) and connect throttle cables (3) to throttle shaft as required. Route opposite end of throttle cables through steering handle (7).	
7 NOTE	
Make sure the throttle position (1) as shown in installation drawing.	
1 2 3 4 4. Install grip (2).	
5. Fully assemble all remaining components as illustrated.	

Twist Handle and Linkage Assembly

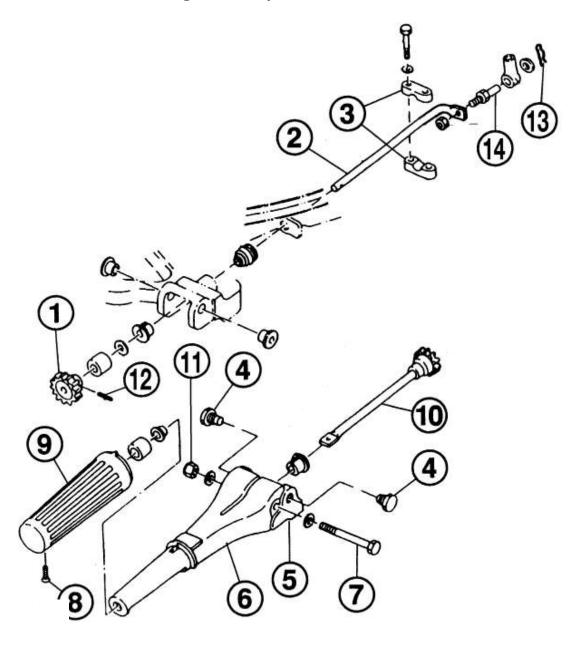
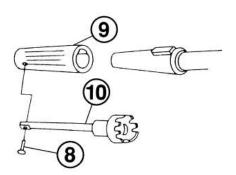
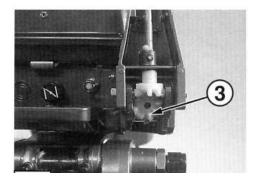


Figure 2. Tiller Arm Subassemblies

Handle and Linkage Disassembly

- 1. Loosen the M6 nylon nut (11) and remove the two handle bolts (4).
- 2. Remove the handle assembly from the steering bracket.
- 3. Remove the Spring pin (12) from the universal pinion (1).
- 4. Remove the R-pin (13) from the cable pin (14).
- 5. Remove the throttle shaft supports (3).
- 6. Remove the throttle shaft B (2) and the universal pinion (1), and relevant parts.
- 7. Remove the handle grip mounting screw (8) and pull out the grip (9) from handle (6).
- 8. Pull out the throttle shaft A (10), and relevant parts.





Twist Handle and Linkage Inspection

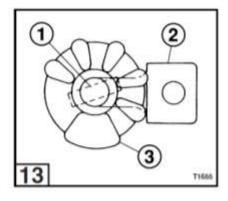
- 1. Check all components for wear or cracks.
- 2. Lubricate all moving surfaces.

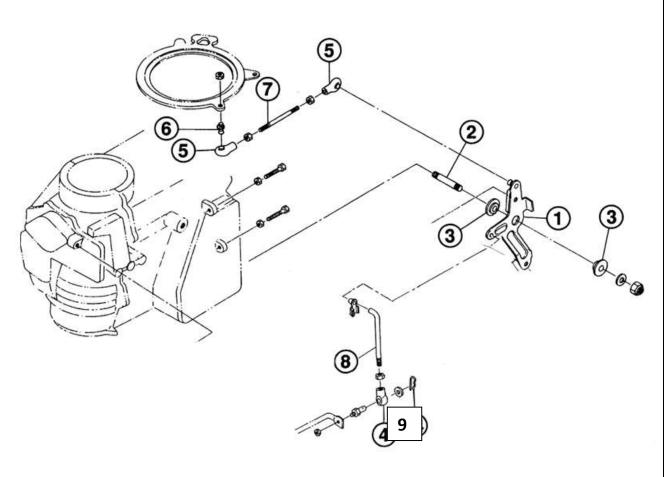
Twist Handle and Linkage Assembly

- 1. Install throttle shaft A (10) after applying grease.
- 2. Install grip on handle A and insert the handle grip (9) and mounting screw (8).
- 3. Install Throttle Shaft B Assembly in the lower motor cover, installing the tip of inner throttle shaft in the proper orientation for the link rod.
- 4. Install the universal pinion (3) after coating with grease. Maintain the relationship between inner throttle shaft and the universal pinion, and inner throttle shaft and the collar as shown.

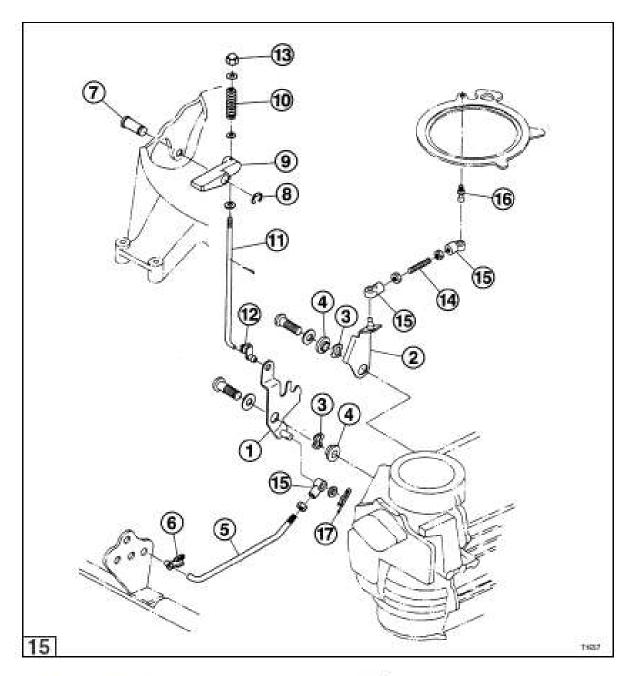
Item	Description
1.	Spring Pin
2.	Throttle Shaft B
3.	Universal Pinion

- 5. Assemble handle and assembly to the steering bracket.
- Tighten the handle friction bolt so that the handle does not drop from the vertical position.
- 7. Install the throttle shaft supports.



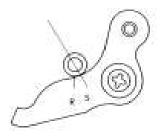


<u>Item</u>	<u>Description</u>
1	Advancer Arm
2	Stud Bolt
3	Advancer Arm Bushing
4	O5 Rod Joint
5	Ball Joint Cap
6	Ball Joint B
7	Advancer Link Rod, 5-50L
8	Handle Link Rod, 5-75L
9	R-Pin, d=8

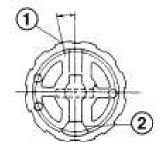


item	Description
1.	Starter Lock Arm
2.	Throttle Stop Arm
3.	Wave Washer
4.	Bushing
5.	Starter Lock Arm Rod
6.	Starter Lock Arm Rod Snap
7.	Starter Lock Lever Shaft
8.	Starter Lock Lever Shaft E-ring
9.	Starter Lock Lever

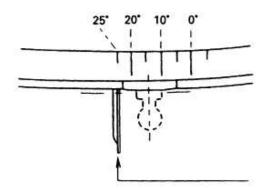
Item	Description	
10.	Starter Lock Spring	
11.	Starter Lock Rod	
12.	Starter Lock Rod Snap	
13.	Starter Lock Lever Cap	
14.	Throttle Stop Arm Rod	
15.	Ball Joint Cap	
16.	Ball Joint B	
17.	R-Pin, d=8	



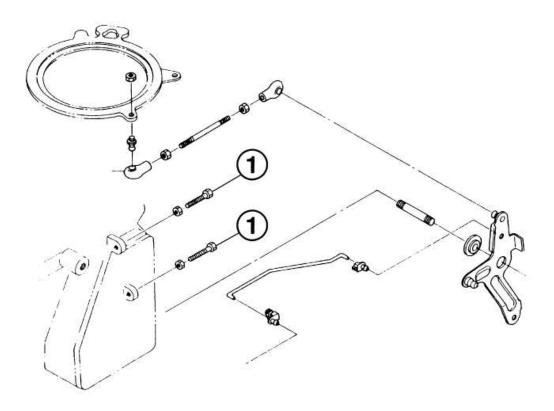
1. Turn the handle grip so that the collar center of the carburetor throttle lever in on the "S" marking line.



2. Adjust the length of the handle link rod so that the START match mark on the handle grip is aligned to the START position on the tiller handle.

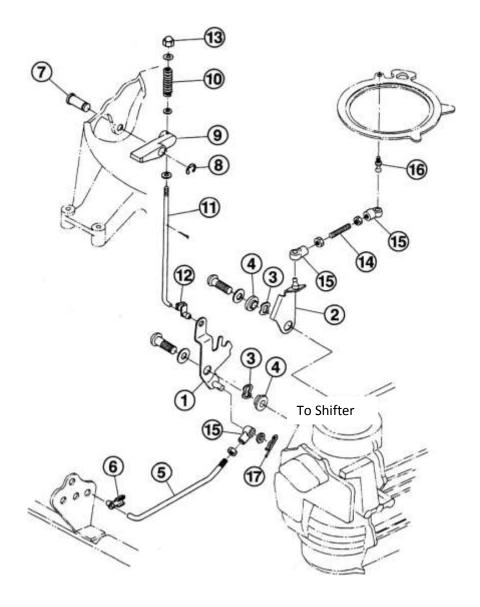


BTDC 25 degrees



. Check that the throttle valve is fully open, and the ignition timing mark at starting comes to the crankcase mating surface. Under this state, adjust the advancer arm stopper bolts (1) so that the advancer arm stops at the throttle valve full-open and full-close positions, and lock the bolts with a nuts.

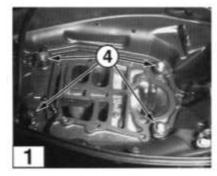
Timing Set at: ATDC 2 degrees

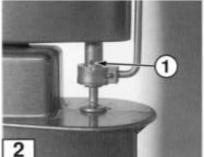


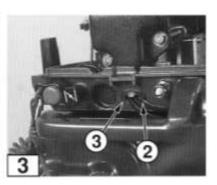
TI657

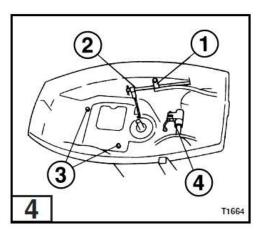
Item	Description
1.	Starter Lock Arm
2.	Throttle Stop Arm
3.	Wave Washer
4.	Bushing
5.	Starter Lock Arm Rod
6.	Starter Lock Arm Rod Snap
7.	Throttle Stop Arm Rod
8.	Ball Joint Cap
9.	Starter Lock Lever

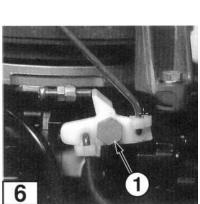
Lower Engine Cover – Raider 40

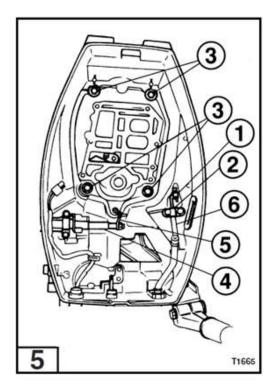












Removal

- 1. Remove powerhead as described in Section 4
- 2. Remove control cables, electrical leads and grommets as required from lower engine cover
- 3. Remove lower engine cover bolts (4)
- 4. Lift cover off engine base

- 5 1. Remove throttle shaft ball joint (1).
- 5 2. Remove upper and lower throttle shaft supports (2).
- **5** 3. Remove lower motor cover bolts (3).
- 4. Raise the cover slightly and remove the shift rod (4) from the shift rod lever (5).
- 5. Remove the lower cover.

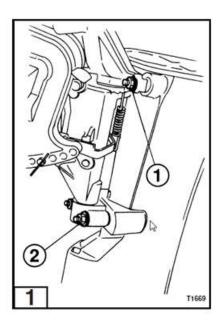
Installation

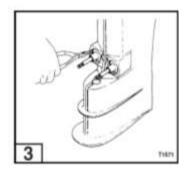
Installation is done in the reverse order of Removal. Use Loctite 242 on throttle stopper bolt (1) if removed.

DRIVESHAFT HOUSING

Removal

- 1. Remove powerhead as described in Section 4.
- 2. Remove tiller steering handle if equipped, this section.
- 3. Remove lower engine cover, this section.
- 4. Remove gearcase as described in Section 6.
- 1 5. Remove upper rubber mount nut (1).
- 6. With driveshaft housing tilted fully down, remove the nut from each lower rubber mount bolt (2). Do not remove the bolts.





△ CAUTION

Driveshaft housing is free to fall if lower rubber mount bolts are removed.

- 7. Hold driveshaft housing securely and pull lower rubber mount bolts and remove driveshaft housing. Place housing on bench for disassembly.
- 8. Remove the clip from the lower rubber mount and remove the upper and lower rubber mounts.

NOTE

use the special tool 361-72760-0 for removing the rubber mounts.



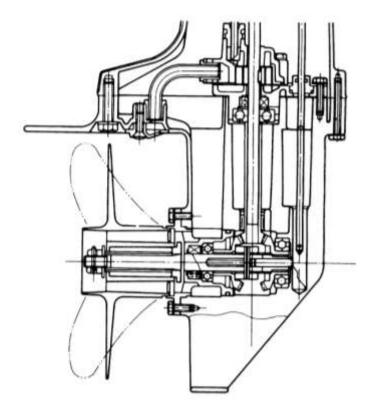
T200

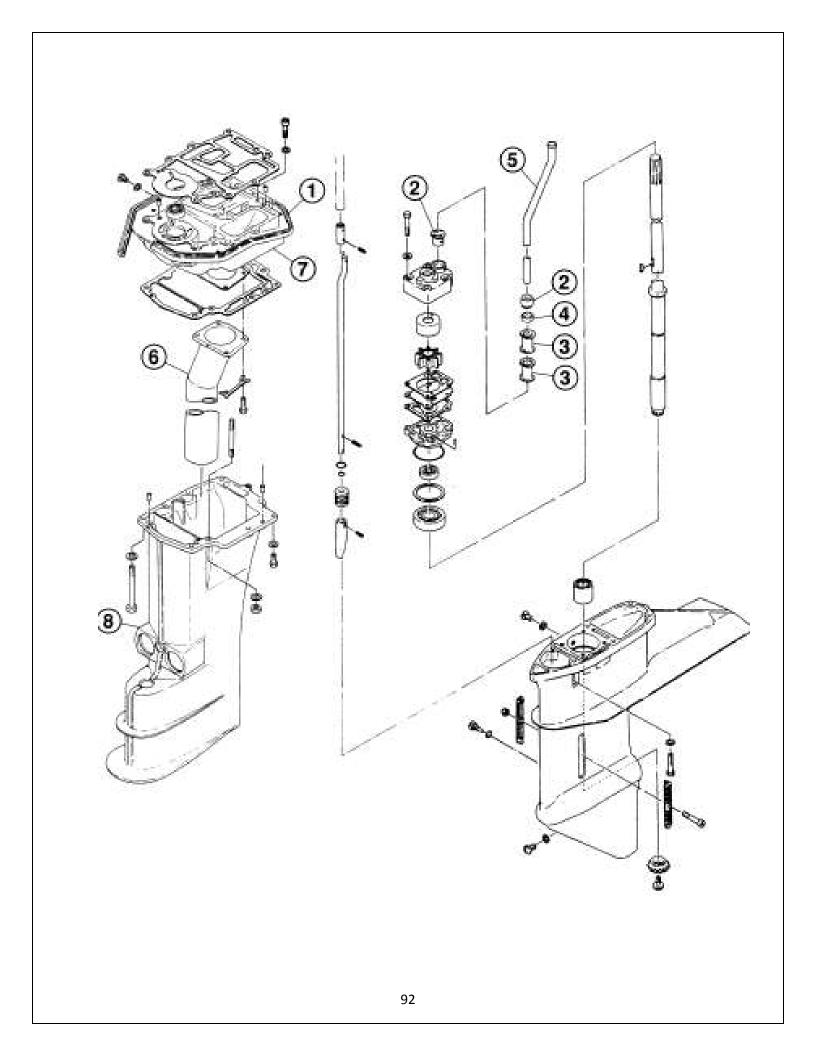
5

! CAUTION

Engine base and driveshaft housing are aligned with dowel pins and may be difficult to separate. Avoid damage to the mating surfaces and gently pry sections apart if necessary.







Cleaning and Inspection

All worn, damaged, or missing parts must be replaced.

- Before cleaning, examine the following rubber parts as applicable and remove if damaged, dry, or brittle;
- 8
- · Lower cover grommets and seal ring
- Lower engine cover seal (1)
- . Water pipe seal (2) locking rubber (3), and rubber set ring (4)

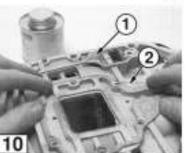
Use super bond adhesive to install new rubber parts as needed on metal surfaces. Make sure metal surfaces are clean and dry before installation of rubber parts.

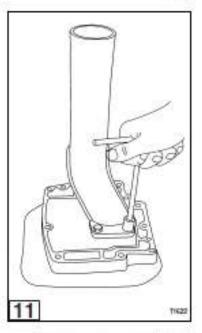
- Thoroughly clean all parts including fasteners with solvent and dry with low pressure compressed air. Verify all carbon deposits, gasket adhesives, and threadlocker residue have been removed.
- Inspect water pipe (5) for kinks or obstruction. Replace as needed.
- Inspect exhaust pipe (6), engine base (7), and driveshaft housing (8) for cracks, chips, dents or other damage.
- 5. Examine the upper and lower rubber mount components for damage or signs of deterioration. Replace as needed.

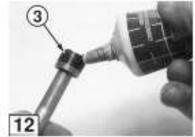
Assembly

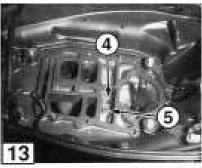
- Verify all new rubber replacement parts have been installed on components as needed.
- Position engine base with powerhead side facing down.
- 3. Mount new exhaust pipe gasket (2) on engine base (1). Apply high temperature gasket dressing to both sides of gasket.
- 11 4. Install exhaust pipe.
- Apply genuine grease or equivalent friction surface marine grease to water pipe seal (3).









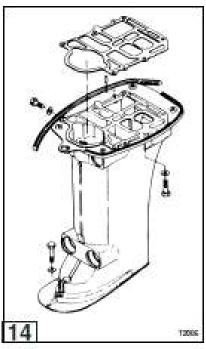


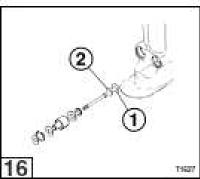
6. Install water pipe (4) in engine base (5) and align for installation in the driveshaft housing.

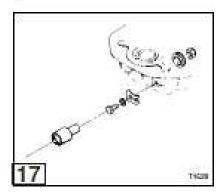
7. Verify knocks (where used) are installed in driveshaft housing. Apply high temperature gasket dressing to both sides of new driveshaft housing gasket and install gasket on housing.

Installation

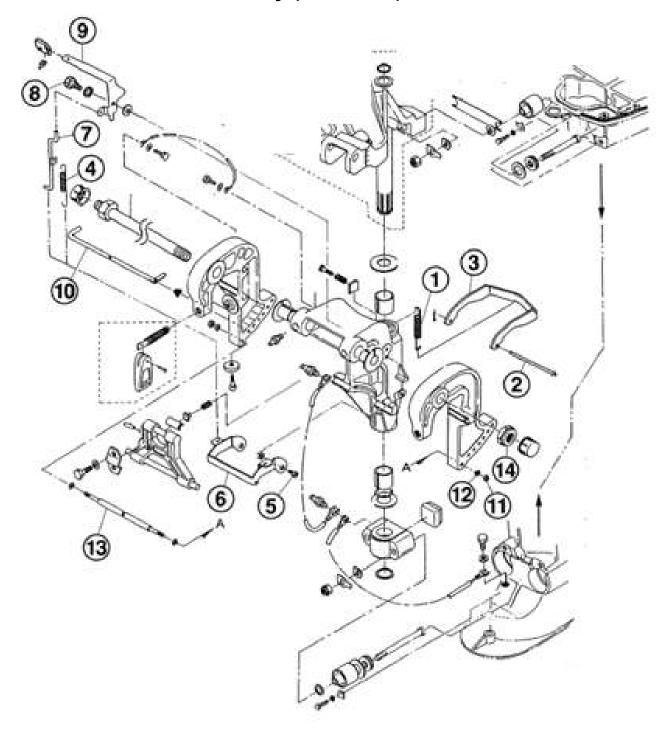
- 1. Insert the damper cap (1) and damper collar (2) into the drive shaft housing.
- 2. Assemble the lower rubber mount components and install them into the drive shaft housing.
- 3. Apply Loctite 243 to bolt threads and torque to specification.
- 4. Install clip.
- 5. Assemble the upper rubber mount components and install them into the engine base.
- 6. Apply Loctite 242 to bolt threads, install the retainer and torque to specification.
- Install gearcase as described in Section 6.
- 8. Install lower engine cover, this section.
- 9. Install tiller steering handle if equipped, this section.
- 10. Install powerhead as described in Section 4.







Stern Bracket – Disassembly (Raider 40)



Stern Bracket - Disassembly

- 1. Remove the reverse lock spring (1)
- 2. Remove the split pin from the reverse lock rod (2) and remove the reverse lock rod (2) and reverse lock (3).
- 3. Remove the reverse lock lever spring (4)
- 4. Remove the reverse lock arm shafts (5) and remove the reverse lock arm (6).
- 5. Remove the reverse lock link (7).
- 6. Remove the reverse lock lever shafts (8) and remove the reverse lock lever (9).
- 7. Remove the thrust rod (10).
- 8. Remove the bracket distance piece nuts (11) and washer (12) and pull out the bracket distance piece (13)
- 9. Remove the bracket nut (14) and separate the brackets.

Swivel Bracket and Reverse Lock

Raider 40 <u>Swivel Bracket</u> <u>Reverse lock</u>

Turning Radius 80 degrees
Port: 40 degrees
Starboard: 40 degrees

Lock all of shifting positions Unlocking is carried out by Operating the reverse lock leve

